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THESIS

**PROCURING CONTRACTING OFFICER'S
GUIDE TO COST/SCHEDULE CONTROL
SYSTEMS CRITERIA (C/SCSC)**

by

Tae H. Lee

June, 1996

Thesis Advisor:
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**PROCURING CONTRACTING OFFICER'S GUIDE TO
COST/SCHEDULE CONTROL SYSTEMS CRITERIA (C/SCSC)**

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Submitted in partial fulfillment
of the requirements for the degree of

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ABSTRACT

This research examined the procuring contracting officer's (PCO) role in implementing and administering Cost/Schedule Control Systems Criteria (C/SCSC) within the Department of Defense. The purpose of this study was to develop a practical guide to C/SCSC for the PCO to use as a ready reference while on the job or in a training environment. As such, some germane topics addressed in this thesis include objectives of C/SCSC, C/SCSC related items of DOD solicitations, evaluation of the contractor's C/SCSC plan or program during source selection, C/SCSC validation and compliance reviews, application of cost and schedule performance data, and current initiatives for improvement of C/SCSC. The underlying goals of this thesis was to make the PCO aware of the importance of reliable cost and schedule performance data to the success of a major acquisition program, and the vital role that (s)he plays in assuring that the contractor's integrated management system generates it.

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I. INTRODUCTION

A. BACKGROUND

On the average, the Department of Defense (DOD) spends approximately one-third of its total annual budget on development and procurement of major weapon systems. These systems are often on the leading edge of technology, take years to field, and typically carry very high price tags. Additionally, the defense industry operates within an oligopolistic market characterized by few sellers, high barriers to entry, and limited competition. Consequently, these conditions have made DOD acquisitions susceptible to inefficiencies that have resulted in cost overruns, schedule slippages, and performance shortfalls. To minimize such occurrences, the DOD issued "Performance Measures on Selected Acquisitions," (DOD Instruction 7000.2) in 1967. This instruction promulgated a set of 35 management standards, collectively termed the Cost/Schedule Control Systems Criteria (C/SCSC) with which all firms doing business with the Government on contracts of a certain size must comply (Fleming, 1983).

C/SCSC (also referred to as "C-Spec," "Earned Value," "CS Squared," and simply "the Criteria") are not a management system imposed by the government. Instead, the criteria

establish minimal standards for the contractor's existing internal planning, scheduling, budgeting, accounting, and analysis systems. During the last 30 years, the C/SCSC concept has undergone continuous refinement and today it has evolved into a highly sophisticated management/control system.

C/SCSC encompasses all the essential features of a good management/control system, such as task planning, budget baseline establishment, measurement of performance at various levels, variance analysis, and corrective action reporting. When used properly, C/SCSC facilitates sound decision making and effective communication between the contractor and Government program management office. Although initially a product of DOD, the C/SCSC concept was found to be so useful it has now migrated over to the procurement activities of other governmental bodies, to private business, and even foreign governments (Fleming, 1983).

In recent years, the DOD's interest in major program cost and schedule performance has been heightened due to the rapidly declining budget for national defense and highly publicized problems experienced by major programs. The Navy's A-12 (Avenger), the Army's AAWS-M (Javelin), and the Air Force's B-2 (Stealth Bomber) are all examples where inadequate use of contractor performance data to manage and control cost

and schedule parameters led to a sudden or premature termination of contract (Abba, 1995).

It is obvious that DOD acquisition in the 1990s will be characterized by ever-tightening controls and increased oversight of all major contracts and subcontracts to ensure that strict performance goals are reached within delineated cost and schedule limits (Coutteau, 1992). Furthermore, in light of the current "downsizing," more than ever DOD acquisition professionals must achieve a thorough understanding of cost and schedule control management, and C/SCSC in particular.

B. RESEARCH OBJECTIVE

The program manager (PM) is overall responsible for meeting the target cost, production schedule, and performance thresholds of the program. However, it must be recognized that the procuring contracting officer (PCO) plays an essential and integral role in achieving these goals. The objective of this research is to provide the PCO with the requisite knowledge necessary for proper implementation, surveillance, and administration of C/SCSC within the DOD arena. The product of this research will be a practical guide to C/SCSC for the PCO to use as a ready reference while on the job or in a training environment. Hence, the focus throughout this guide will be on

the PCO functions within the C/SCSC process. As such, some germane topics to be addressed include objectives of C/SCSC, C/SCSC related items of DOD solicitation, evaluation of the contractor's C/SCSC plan or program during source selection, application and use of C/SCSC data, C/SCSC compliance validation reviews, and current initiatives for improvement of C/SCSC. This guide is not an attempt to make the PCO an "expert" in C/SCSC. Rather, the goal is to make the PCO aware of the importance of reliable cost and schedule (C/S) performance data and the vital role he or she plays in assuring that the contractor's integrated management systems (IMS) generates it.

C. RESEARCH QUESTIONS

The primary question that this research seeks to answer is:

What should the procuring contracting officer (PCO) understand to successfully implement and administer C/SCSC in major acquisition programs?

The following basic subsidiary questions were developed to define the primary research question:

1. What is the main product of the C/SCSC process, and why is it useful to the DOD and to the procuring activity in particular?
2. What are the key earned value (C/SCSC) considerations in request for proposal (RFP) preparation, and what evaluation and validation

procedures are employed for DOD contracts requiring C/SCSC?

3. What are some significant technological and policy initiatives currently being undertaken or considered to improve the timeliness and utility of cost and schedule data?
4. What effect have the recent acquisition reform initiatives had on the C/SCSC process?

D. SCOPE LIMITATION AND ASSUMPTION

1. Scope

Although there are numerous literary materials relating to contract performance measurement and the more specific topic of C/SCSC, the vast majority have been written primarily for the DOD program managers and contract performance measurement (CPM) analysts who are the primary users of the C/S performance data. The focus of this study will be on the specific tasks that C/SCSC has placed on the PCO.

2. Limitations

As stated earlier, C/SCSC is now widely used outside of DOD. However, this research is limited to application within the context of major DOD acquisition programs. Furthermore, the scope of this research is limited to C/SCSC philosophy and does not encompass techniques for analysis of C/S performance data.

E. METHODOLOGY

The author's first-hand experience working with C/SCSC while assigned as a U.S. Navy Business Financial Management Trainee (BFMT) at the Naval Sea Systems Command from 1990 to 1992 was utilized as a basis for further research.

A comprehensive literature search from all accessible resources, including the Naval Post Graduate School Dudley Knox Library, the Defense Logistics Studies Information Exchange (DLSIE), Defense Technical Information Center (DTIC), and the World Wide Web (WWW), resulted in amassing a plethora of germane information that are imparted in this thesis.

This research was also supplemented by telephonic and personal interviews with various personnel involved with C/SCSC policy development, training, implementation and administration. These "experts" were instrumental in providing the author with the most current and significant developments surrounding C/SCSC. To facilitate this research, the author made the assumption that the individuals participating in this study gave the viewpoint of the organizational entities rather than their personal opinions.

F. ABBREVIATIONS AND DEFINITIONS

Abbreviations and definitions used throughout this thesis are included as Appendices A and B, respectively.

G. ORGANIZATION OF STUDY

This thesis is organized into five chapters. Pertinent subjects have been identified by chapter heading. The following chapter provides an overview of C/SCSC, which includes its history, objectives, applicability, policy and procedures. The third chapter addresses the PCO's involvement and responsibilities within the C/SCSC implementation and surveillance process. Chapter IV will present current developments and issues surrounding C/SCSC. Finally, Chapter V will provide findings to answer the research questions and recommendations generated by this study.

II. OVERVIEW OF C/SCSC

A. CHAPTER INTRODUCTION

The objective of this chapter is to introduce the PCO to the core concepts and basic requirements of C/SCSC. This will be accomplished through a brief review of the historical development of C/SCSC, followed by a discussion of its purpose, applicability, policy, and procedures. This chapter will also address the four major types of contract performance/status reports generated by the criteria process and define key terminology that pertains to earned value management.

B. HISTORICAL PERSPECTIVE

The concept of contract performance measurement did not begin with the inception of C/SCSC. This concept and practice have been in existence in one form or another for more than forty years (Coutteau, 1992). DOD recognized the need for improved methods of controlling costs and monitoring contractor progress since the early 1950's when it was confronted with economic inflation, expanding technological complexity, long procurement lead times, and growing uncertainty within the defense industry (Weisburg, 1974). Also during this time, the primary type of contract used for DOD

procurement was cost plus fixed fee (CPFF). It is widely held that the dependence on CPFF contracts was one cause of lack of cost consciousness that led to the development of several innovative cost and schedule management systems or methods from the various agencies of DOD. (Mattox, 1988)

Among the first to be developed was the Department of Navy's Program Evaluation and Review Technique (PERT). PERT was specifically developed for use in the Navy's Polaris Fleet Ballistic Missile Program in the late 1950s and early 1960s. PERT allowed the Navy to coordinate and track the activities of more than 3,000 companies and Government organizations involved with this program. (Sweeney, 1992)

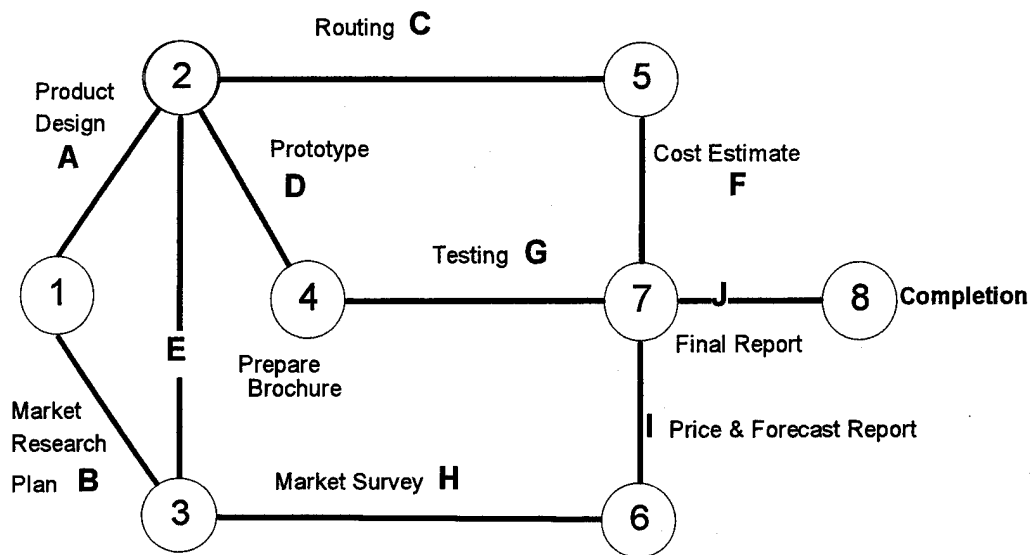
Since many jobs or activities associated with the Polaris missile project had never been attempted previously, it was difficult to predict the completion times of the various jobs or activities. Consequently, PERT was developed to handle uncertainties in activity completion times. Its approach was to link together planned events and tasks to show the relationship and constraints between them and, in doing so, identify the longest sequential path of the project (Sherman, 1995). Management would then focus on this "critical path" to complete projects in the shortest possible time. An example of a PERT network diagram for a hypothetical project is shown in

Figure 1. Note that the network shows the predecessor relationships of the various activities for the project.

PERT or critical path method (CPM) is still widely used today to help answer the following pertinent questions:

- What is the total time to complete the project?
- What are the schedule start and finish dates for each specific activity?
- Which activities are critical and must be completed exactly as scheduled to keep the project on schedule?
- How long can noncritical activities be delayed before they cause a delay in the total project? (Anderson, Sweeney, Williams, 1994)

Obviously, PERT/CPM concentrates on the time aspect of a project. Although project time is a primary consideration for almost every project, cost associated with the project is often just as important as time. In 1963, an upgraded version of PERT, PERT-Cost, was developed by the Air Force and employed in the Minuteman Missile Program. PERT-Cost added the capability to budget, control and report project costs (Gadekan, Tison, 1983). This was the introduction of the concept known as "earned value" that became the foundation for all future developments in performance measurement systems [Fleming, 1983].



| Activity | Description | Immediate Predecessor |
|----------|------------------------------------|-----------------------|
| A | Develop product design | --- |
| B | Plan market research | --- |
| C | Prepare routing (mfg. engineering) | A |
| D | Build prototype model | A |
| E | Prepare market brochure | A |
| F | Prepare cost estimates | C |
| G | Do preliminary product testing | D |
| H | Complete market survey | B, E |
| I | Prepare pricing & forecast report | H |
| J | Prepare final report | F, G, I |

Figure 1. Example of a Pert Network Diagram. After Ref. (Anderson, Sweeney, Williams, 1994)

Encouraged by the overall success of the Polaris and Minuteman Programs, the Government attempted to employ the PERT concept on all major contracts. However, this was met with failure because of a number of issues unrelated to the technique itself. In many cases the technique simply did not work because of poor implementation by the Government. But the main cause was inadequate computer technology and software programs to support the new concept (Fleming, 1983). As a result, contractors often prepared the PERT reports solely for delivery to Government agencies, while continuing to manage the project using existing management processes (Sherman, 1995). Under these conditions, the Government-mandated PERT was ineffective in aiding the Government to gain better control of project costs and schedules.

Consequently, the Assistant Secretary of Defense (Comptroller) decided that DOD should remove itself from the business of management systems design, and it should rely upon the contractor's internal control systems (Worrall, 1982). This decision necessitated some assurance that all contractors would integrate their data about some common baseline which would be effective for Government analysis purposes. The common baseline was developed in 1966 by the Director, Defense Research and Engineering, and it was in the form of a standard work breakdown structure (WBS) (Durbrow, 1974).

As the term implies, a WBS breaks a program into its component elements of hardware, software, services and program unique tasks (Chasko, 1978). These elements can then be organized, defined and graphically displayed to show their relationship to each other and to the program as a whole. An example of a WBS for a hypothetical airplane system is shown in Figure 2. Because WBS is fundamental to C/S performance measurement, it will be discussed frequently throughout this guide.

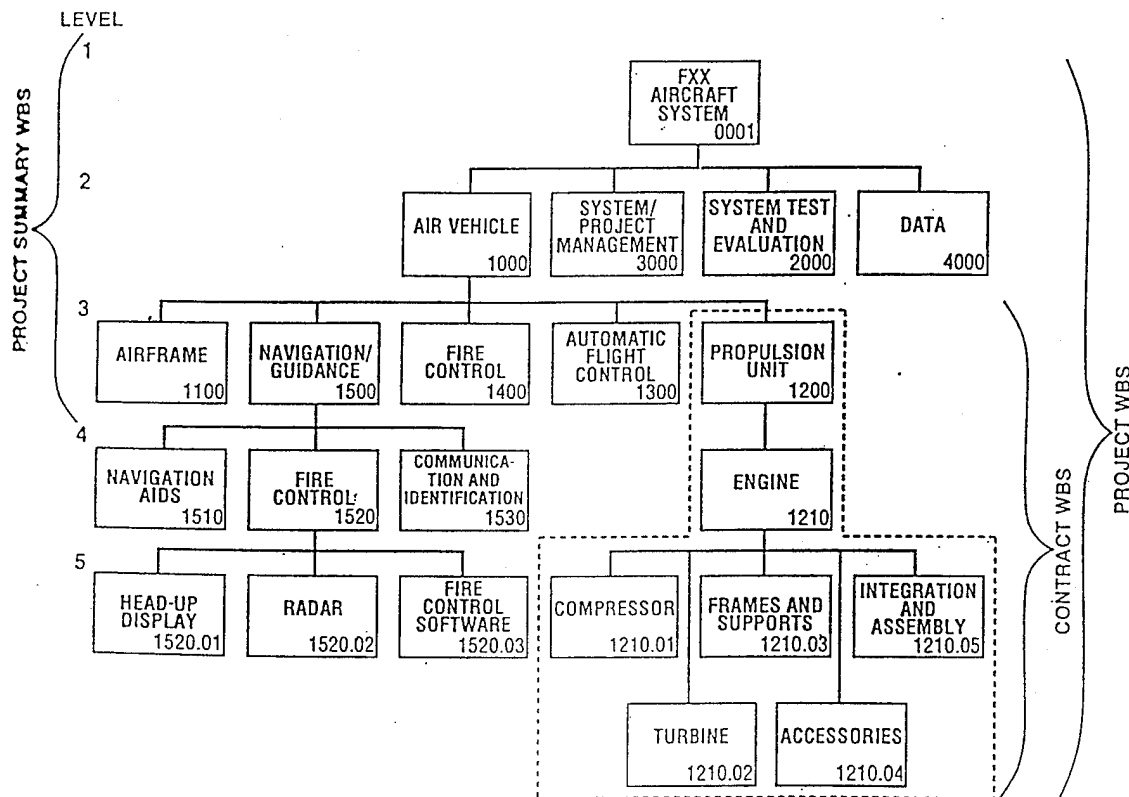


Figure 2. Example of a Work Breakdown Structure.
After Ref. (Fleming, 1983)

The Air Force continued to expand upon the earned value management concept and developed a set of simplified standards to qualify a contractor's internal management systems for defense work. These standards, called Cost/Schedule Planning and Control Specification (or C-Spec), contained those attributes that a capable contractor management control system should exhibit. C-Spec permitted the contractor to establish and utilize the internal processes of his choosing; however, it required that he demonstrate his process compliance with the C-Spec. (Gadeken, Tison, 1983)

In 1967, the Comptroller issued DOD Instruction 7000.2, Performance Measurement for Selected Acquisitions. This document defined 35 criteria or standards collectively known as Cost/Schedule Control Systems Criteria (C/SCSC), which the DOD would henceforth require of DOD contractors and their management control systems (Fleming, 1983). These same 35 criteria are in place today, essentially unchanged, almost three decades later. A complete description and listing of all 35 criteria are provided in Appendix C.

To avoid imposing multiple cost and schedule systems on contractors, and to ensure some semblance of uniformity in the application of C/SCSC within the Services, DOD issued the Cost/Schedule Control Systems Criteria Joint Implementation Guide (commonly referred to as the JIG) in 1970. Subsequently

updated four times, the JIG is currently undergoing another revision to reflect the latest developments in C/SCSC.

In 1991, DODI 7000.2 was canceled and incorporated into DODI 5000.2, Defense Acquisition Management Policies and Procedures. C/SCSC is covered in Part 11, Section B, "Contract Performance Measurement" (DODI 5000.2, 1991). Specific references to the various reports associated with C/SCSC are addressed within DOD 5000.2-M, Defense Acquisition Management Documentation and Reports, part 20, "Cost Management Reports." Part 20 replaces DODI 7000.1, Contractor Cost Performance Fund Status and Cost/Schedule Status Reports and DODI 7000.11, Contractor Cost Performance Data Reporting (DODI 5000.2-M, 1991).

C. CRITERIA APPLICABILITY

Compliance with C/SCSC is required on selected contracts within those programs designated as major systems acquisitions. In accordance with DOD Directive 5000.1, major contracts are those meeting the following conditions:

- Having an estimated dollar value of research, development, test and evaluation (RDT&E) in excess of \$60 million (in FY 1990 constant) dollars.
- Having an estimated dollar value for production in excess of \$250 million (in FY 1990 constant) dollars. (DOD Directive 5000.1, 1991)

Subcontracts are selected for C/SCSC application based on the criticality of the subcontract to the program as mutually determined by the procuring activity and the prime contractor. (Kemps, 1978)

Compliance with C/SCSC is not required on firm-fixed-price contracts (nor fixed-price contracts with economic price adjustment escalation provisions), time and material contracts, and contracts that consist of mostly level-of-effort work. However, all other types of contracts, including fixed-price-incentives, may have C/SCSC applied. (C/SCSC JIG, 1987)

D. C/SCSC OBJECTIVES, POLICIES, AND PROCEDURES

It is important to note that the C/SCSC does not represent a management control system. Rather, the criteria merely specify those minimum requirements which a contractor's management control system must satisfy (Christensen 1995). According to the JIG, the criteria were issued with two primary objectives:

- For contractors to use effective internal cost and schedule management control systems, and
- For the Government to be able to rely on timely and auditable data produced by those systems for determining product-oriented contract status. (C/SCSC JIG, 1987)

The criteria approach is intended to provide the contractor with a maximum amount of flexibility in determining how he wishes to conduct his internal operations. To avoid imposing unnecessary changes to contractors' existing systems, this policy advocates a single internal management system that satisfies both the contractors' and DOD's needs for cost/schedule performance information (Kemps, 1978). In short, the DODI 5000.2 delineates the following policy and procedures:

- Minimize changes to contractors' existing systems.
- Single system for internal management and government reporting.
- Avoid imposition of specific systems.
- Avoid proliferation of demands for demonstrations of systems. (DODI 5000.2, 1991)

E. FIVE AREAS OF C/SCSC

The 35 criteria are grouped into five major categories. Generally, the five areas deal with the following requirements:

1. Organization. These criteria require that the contractor's system provide for clear definition of the overall contractual effort using a work breakdown structure (WBS) as a framework for displaying subdivision of effort. Integration of the WBS with the functional organization structure is required in order to establish responsibility for

identified work tasks. Additionally, the planning, scheduling, budgeting, work authorizing and cost accumulating subsystems should be integrated with each other, the WBS, and the organizational structure.

2. Planning and Budgeting. All authorized contract work must be planned, scheduled, budgeted and authorized within the system. Establishment of the performance measurement baseline (PMB) is the key requirement of this section.
3. Accounting. Costs of completed work must be recorded and summarized to the contract level as directly as possible, avoiding allocations in summation. Cost of materials should be collected and compared to budgeted costs after the materials are received and are available for use. Accounting for material costs may vary depending on the type of material involved.
4. Analysis. Comparisons of actual versus planned performance are required by this group of criteria. Thresholds for variances should be established to avoid excess effort and it is particularly important that variances be examined in terms of increments or aggregations of works which are large enough to produce significant information. Analyzing individual work package variances, for example, should be unnecessary and would probably not be cost effective.
5. Revisions and Access to Data. Incorporation of changes authorized by the Government and necessitated by internal replanning are dealt with in this section. Particular emphasis is placed on the need to retain a meaningful performance measurement baseline. Other requirements include reconciliation of estimated costs at completion with funds requirement reports and provisions for access for systems evaluations. (Kemps, 1978)

Table 1, below shows a breakdown of the 35 criteria by major category group (see Appendix C for a complete listing and description of all 35 criteria).

| CATEGORY | TOTAL # | DESCRIPTION |
|----------------------------|---------|--|
| Organization | 5 | Define contractual effort and assign responsibilities for the work |
| Planning & Budgeting | 11 | Plan, schedule, budget and authorize the work |
| Accounting | 7 | Accumulate costs of work and material |
| Analysis | 6 | Compare planned and actual costs and analyze variances |
| Revisions & Access to Data | 6 | Incorporate changes and develop estimates of final costs |

Table 1. C/SCSC By Category Group.
After Ref. (Clark, 1995)

F. C/SCSC REQUIREMENTS AND EARNED VALUE

Figure 3, on the following page illustrates the three basic requirements of C/SCSC. First, the contractual effort is defined using the WBS as an aid to subdividing and displaying units of work. Second, scheduling and budgeting the work produces a time phased performance measurement baseline (PMB), which effectively integrates the work, schedule and budget with each other. Lastly, since the intent is to measure contract performance, the schedule and budget is oriented to contractual targets (Clark, 1995).

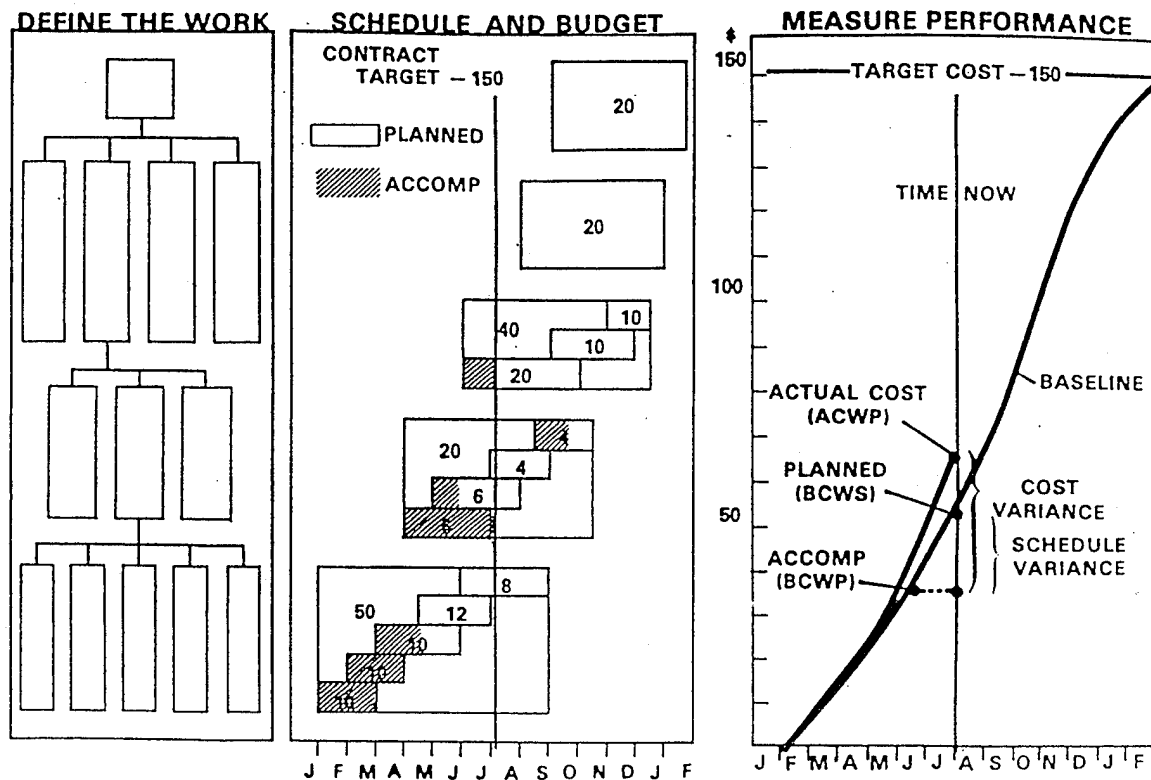


Figure 3. Three Basic C/SCSC Requirements
Ref. (Kemps, 1978)

Once the WBS has been defined and PMB is established, the next step is to monitor and report progress against the plan. The criteria specifically require contractors' systems to be capable of providing the following earned value information:

- Budgeted Cost of Work Scheduled
- Budgeted Cost of Work Performed
- Actual Cost of Work Performed
- Cost and Schedule Variances and Explanations
- Traceability

- Budgeted Cost at Completion
- Estimated Cost at Completion

The Budgeted Cost of Work Scheduled (BCWS) represents the value of the work (including level of effort and apportioned effort) the contractor planned to do as of a given point in time. The Budgeted Cost of Work Performed (BCWP), represents the value of completed work. The comparison of BCWS with BCWP indicates whether more or less work was done than was scheduled to be done. The difference is the schedule variance (SV), and is expressed in terms of dollars. A negative SV indicates a schedule slippage; conversely, a positive SV indicates that the program is ahead of schedule (Sherman, 1995).

Actual Cost of Work Performed (ACWP) represents the costs actually incurred in accomplishing the work as of the date of analysis. Comparing BCWP with the ACWP indicates whether the work that was performed cost more or less than it was planned to cost. The difference is the cost variance (CV). A positive CV reflects a favorable or cost underrun condition, while a negative CV indicates a unfavorable or cost overrun program status (Sherman, 1995).

Both cost and schedule variances are tracked at the lowest level of the WBS, known as the cost account. A cost account is the natural control point since it represents the

work assigned to a single organizational unit on one WBS element (Kemps, 1978). The total CV and SV for the program is obtained by simply adding all the individual cost account variances.

The analysis of every cost and schedule variance is unnecessary and unproductive; therefore, it is important to establish reasonable variance thresholds and analyze only those variances that are significant (C/CSC JIG, 1987). Generally, thresholds are established requiring a variance analysis for any cost or schedule variance that exceeds a certain percentage of BCWS or BCWP and/or exceeds an established dollar minimum (for example, +/- 10% of cumulative BCWS, or \$10,000, whichever is greater) (C/SCSC JIG, 1987).

Unfavorable variances do not always mean poor performance by the people doing the job. An unfavorable cost variance could be attributable to a number of reasons other than technical problems, such as inflation, labor rate and material cost increases, poor initial planning or estimates, and so forth (Fleming, 1983). Schedule variance by itself reveals no "critical path" and may be misleading, because unfavorable accomplishments in some areas may be offset by favorable accomplishments in another and vice versa. Detailed analysis of significant cost and schedule variances is essential to pinpointing problems and determining reasons for deviations

from plan; hence, the requirement for traceability. A C/SCSC compliant system is structured in such a fashion that significant variances can be quickly and easily traced to their source. (Clark, 1995)

In addition to the variance analysis, there are three key performance indices that are used to determine contractors' efficiency. First is the Cost Performance Index (CPI). Calculated as a ratio of BCWP to ACWP, it expresses the proportion of planned value received for dollars spent. If the ratio is greater than 1.0, this indicates that work has been achieved with less cost than budgeted (underrun). Conversely if less than 1.0, it indicates that an overrun condition exists as of the date of analysis. (AFSCP 173-4, 1989)

The Schedule Performance Index (SPI) gives an indication of schedule status, and is calculated as a ratio of BCWP to BCWS. A value greater than 1.0 means that the program is ahead of schedule, and less than 1.0 corresponds to behind schedule. (AFSCP 173-4. 1989)

The third efficiency index is the To-Complete Performance Index (TCPI). Calculated as $(BAC-BCWP)/(BAC-ACWP)$, the TCPI tells what the CPI will have to be on the remaining contractual effort in order to achieve the contractor's latest revised estimate (LRE) (AFSCP 173-4, 1989). For example, if the

TCPI equals 1.08, then the contractor's CPI must be at least equal to 1.08 for the remainder of the contract, or the program will result in a cost overrun.

Based on performance to date and estimates of future conditions, an estimated cost at completion (EAC) can be computed. EAC is the sum of all ACWP to date plus an estimate of the cost of the remaining work (C/SCSC JIG, 1987). There are several different methods of computing an EAC, ranging from highly detailed (bottom up/grass root) to perfunctory (managerial experience); however, EACs based on a combination of weighted SPI and CPI are the most common. The BAC is the summation of all BCWS plus an amount of management reserve withheld. At the contract level, the BAC is usually equal to the contract value. The difference between EAC and BAC will provide a variance at completion (VAC), which is a forecast of contract overrun or underrun. Research has shown that once a program is more than 15% to 20% complete, it is highly unlikely that the final cost overrun will be less than the present cost overrun (Christensen, 1994). Therefore, contractor and Government program managers should guard against being too subjective and overly optimistic in the development and reporting of their EACs. A list of basic earned value analysis formulas are provided in Appendix D.

G. C/SCSC REPORTS

1. Cost Performance Report (CPR)

The CPR (Data Item Description DI-F-6000C) is the principal Government document to measure the contractor's contract performance on a major defense contract. DODI 5000.2-M, states that the CPR is required on all contracts which must comply with C/SCSC. The benefits to the program office using the CPR include the following:

- It serves as a basis to verify the accuracy of informal information and the validity of the contractor's LRE.
- It provides the means to monitor and evaluate contract/contractor performance.
- It isolates long-term trends and provides early identification of cost/schedule problems.
- It shows the cost impact of known problems.

The CPR is the heart of the C/SCSC activity and provides demonstrative proof to the Government that the criteria have been properly implemented. The inability of a contractor to submit a CPR, and to consistently track performance to it, sends out a clear signal to the Government that something is wrong. (Fleming, 1983)

The CPR is also an extremely important document for reporting of program status to higher authority. CPR data are a major source of input to the Defense Acquisition Executive Summary (DAES), the Selected Acquisition Report (SAR), and the

Integrated Program Summary (IPS). All three reports originate with the program office. The DAES is submitted quarterly to USD(A&T), via the Program Executive Officer (PEO) and Service Acquisition Executive (SAE). The purpose of the DAES is to provide advance warning of program problems before they become significant. The SAR is submitted annually to Congress via the appropriate chains of authority. The SAR provides a summary of key cost, schedule, and performance information relative to the baseline program acquisition unit cost (PAUC). The IPS incorporates CPR data in order to provide current execution status of the contract to the Defense Acquisition Board (DAB) in support of major program milestone reviews. (DODI 5000.2, 1991)

The CPR contains five separate formats and is the most detailed performance report sought by the Government. Since CPR reporting is related to the WBS, the bottom line should reflect total contract performance (Clark, 1995). The report contents specified in each contract can be tailored by the procuring activity to meet its needs. The five formats of CPR as described in the Defense Systems Management College (DSMC) PM's Notebook are as follows:

- Format 1. This format provides both current (most recent accounting period) and cumulative (start of contract through last period) performance data elements segregated by WBS.

- Format 2. Contract effort segregated by functional organization is presented on this format. The bottom line contract totals equal those on Format 1. It is the same contract data from a different viewpoint. Functional organization performance data are displayed in exactly the same way as are the WBS elements showing: current period, cumulative data, budget at completion (BAC), and latest revised estimate (LRE) values.
- Format 3. The time-phased dollarized budgets are displayed for: current period, cumulative values to date, the next six months and for five additional specified periods which take the contract to completion. Changes to future period budgets, application of management reserve (MR), and distribution of undistributed budget (UB), if applicable are identified here.
- Format 4. Manpower projections for those functional organizations listed on Format 2 are shown here. Presented are data representing: current period, cumulative to date, the next six months and five specified periods extending to contract completion. These data allow managers to compare the remaining work on the contract to other projected manpower mix planned to accomplish it.
- Format 5. The problem analysis format addresses: the overall contract status, significant schedule and cost variances that result from data analysis, differences between planned and actual achievements, reasons for baseline changes, use of management reserve with rationale and any other contractual issues requiring management visibility. The information explains both what has happened; i.e., history that created the current status and actions being taken to solve problems, implement work arounds, conduct replanning of future activities and identify associated costs. (DSMC Fact Sheet No. 2.4.1, 1989)

Normally, the CPR is submitted about 25 days after the close of the contractor's accounting month; but, with the advent of automated programs, the CPR has become more timely, now that it can be provided on a computer disk or over a modem.

The Performance Analyzer (PA) is a widely used automated program which allows the procuring activity to perform in-depth CPR analysis on almost any personal computer. The PA contains three modules that automatically calculates both current and cumulative cost and schedule variances, performance indices and estimates at completion (EAC). The PA also allows for transfer of data using electronic data interface (EDI). Chapter IV will address this and other technological developments in greater detail.

2. Cost Schedule Status Report (C/SSR)

The C/SSR (Data Item Description DI-F-6010A) was designed for use on lower dollar contracts (over \$5 million but below the C/SCSC thresholds). This does not require government validation of the contractor's management control system and it offers the contractor maximum flexibility in data management (C/SSR Joint Guide, 1978). The assumption is that the contractor's system is adequate.

C/SSR contains only two formats, as compared with the five formats of the CPR. It provides a format similar to

format 1 of the CPR, but contains only cumulative data for WBS elements. The second is the problem analysis presentation, similar to CPR format 5. This report does not contain organizational, baseline, and manpower projection data.

3. Contract Funds Status Report (CFSR)

On all cost reimbursable type contracts, a funding profile is normally established at the time of award. However, the very conditions which make a cost type contract appropriate (i.e., the likelihood of changes and redirection) may also cause the funding profile to change during the course of the program. Therefore, on all DOD cost type contracts of six months duration and over \$1,000,000 in value, a Contract Funds Status Report (CFSR) (Data Item Description DI-F-6004) is required quarterly to forecast the necessary program funding required (Fleming, 1983). The CFSR provides the contractor's estimate of funding requirements by contract line item, WBS element and appropriation. Firm-fixed price contracts do not generally call for a CFSR because they are fully funded at time of contract award.

4. Contract Cost Data report (CCDR)

The fourth and last report used in conjunction with C/SCSC is the Contract Cost Data Report (CCDR) (DD Forms 1921 series). The CCDR is a general title actually covering four distinct cost reports. The CCDR system was established

primarily to create a historical data base for future cost estimating efforts. For example, the CCDR provides the means to compare one system (i.e., aircraft) with all other related systems. All programs that are designated as major systems acquisitions by the Secretary of Defense are covered by the CCDR requirements, unless specifically waived by the Chair, OSD Cost Analysis Improvement Group (CAIG). Generally, CCDR will not be required on contracts below \$2 million (DODI 5000.2-M, 1991).

H. DOD COMPONENT RELATIONSHIPS

Successful application of the criteria requires the participation and coordinated efforts of various DOD components. These organizations include the Acquisition Policy and Program Integration/Cost Management (AP&PI/CM) section within the OUSD(A&T), the Defense Contract Audit Agency (DCAA), and the Defense Logistics Agency (DLA).

The office of AP&PI/CM is assigned the responsibility for implementing C/SCSC throughout DOD and oversight of major contractor cost management reports. The personnel within this office also review contractor cost performance data submitted by the various Service acquisition program offices and provide assessments of the data to senior DOD management, including

the USD(A&T), in support of major program milestone reviews (Abba, 1996).

DCAA plays an important part in the C/SCSC implementation. DCAA auditors serve as C/SCSC review team members for the review of accounting systems and related financial areas, including budgeting, direct and indirect costs, variance analysis, and forecasting (C/SCSC JIG, 1987). Together with the cognizant contract administration office (CAO), this organization is also actively involved with the surveillance effort. Specific tasks performed include monitoring system integrity, analysis of system output, preparation of audit reports, and validation of a contractor's latest revised estimate (LRE).

The DLA is also closely involved in the C/SCSC implementation process. The DLA through its Defense Contract Management Command (DCMC) provides contract administrative services to the procuring activity. The DCMC is organized into two geographical Defense Contract Management Districts (DCMD). Each DCMD provides contract administrative services for the customers assigned to it. Each DCMD has several Defense Plant Representative Offices (DPRO) and Defense Contract Management Area Operations (DCMAO). Each of these organizations provides contract administrative services, program support evaluations, contractor performance analysis, Cost Accounting Standards

(CAS) compliance audits, and contractor C/SCSC system surveillance to the DOD buying commands. (Coutteau, 1992)

For many years, the Performance Measurement Joint Executive Group (PMJEG) was responsible for providing top level, joint policy and procedure recommendations regarding C/SCSC in order to present a "single face to industry." Each Service component, as well as DLA, DCAA and the National Security Agency (NSA) was represented on the PMJEG. Recently, the PMJEG committee structure was dissolved in favor of an executive from the DCMC. According to Dr. Kaminski, Under Secretary of Defense (Acquisition and Technology) "the PMJEG policy changes are intended to simplify and streamline the C/SCSC review and acceptance process, and to develop a management structure that will encourage responsible, timely innovation." (Kaminski, 4 December 1995)

I. CHAPTER SUMMARY

Chapter II has provided a broad but substantive overview of the Cost/Schedule Control Systems Criteria. It introduced key concepts, requirements, terminology, documentation, and organizations that are associated with C/SCSC.

The next chapter will continue to build upon the material presented thus far and provide the PCO with an understanding

of his/her responsibilities and involvement in the C/SCSC
implementation and surveillance process.

III. PROCURING CONTRACTING OFFICER C/SCSC RESPONSIBILITIES

A. CHAPTER INTRODUCTION

In this chapter, the various C/SCSC activities that transpire during a typical procurement cycle are examined in order to identify the PCO's specific C/SCSC involvement and responsibilities. As in the preceding chapter, the more pertinent areas related to this reference guide are discussed. Figure 4, depicts the chronological order of events that will be followed in the discussion of topics. Through clear understanding of the PCO functions, the implementation, surveillance, and administration of C/SCSC should be enhanced.

| | | | | | |
|--|--|-------------------------|-------------------------|------------|---------------------------|
| Evaluation of Proposals (Preaward) | Implementation Visit (After Contract Award) | Readiness Assessment | Demonstration Review | Acceptance | Surveillance: Phase II |
| | Surveillance: Phase I | | | | |

Figure 4. Typical Phases of C/SCSC.
After Ref.(C/SCSC JIG, 1987)

B. PRE-AWARD ACTIONS

1. Acquisition Plan

The Acquisition Plan is a key document in the pre-contract phase. The Plan details the procurement process for the required hardware, software and/or services. In the management section of the Acquisition Plan, the procuring

activity should address the management information requirements as they relate to the cost, schedule and technical risks (Clark, 1995).

Studies have shown that the cost of implementing C/SCSC can be as high as 7-11 percent of total contract cost (Mattox, 1988). Therefore, if the use of C/SCSC in the proposed contract is not mandatory (based on regulations), the PCO should conduct an in-depth analysis to determine whether the benefits outweigh the costs.

2. Solicitation Preparation

a. C/SCSC Contract Clause

The preparation and use of the request for proposal (RFP) to solicit offers is one of the PCO's major tasks, and the clarity of the RFP is a key factor in conducting a successful competition. As mentioned earlier, C/SCSC is required on all major contracts, and for such contracts the PCO should ensure that the DOD FAR Supplement solicitation provision 52.234-7000 and contract clause 52.242-7001 are included as part of the RFP package and subsequent contract. The full C/SCSC solicitation provision and contract clause can be found in Appendixes A and B of the JIG. In short, the contract clause stipulates:

- A contractor will use only approved C/SCSC management systems throughout the performance of the contract.

- A contractor will be ready to demonstrate his system's compliance with C/SCSC standards to a Government Review Team within 90 days (or as otherwise specified) after contract award.
- A contractor must ensure all relevant documents, data, and records associated with his management systems are readily accessible for Government review and surveillance.
- A contractor will ensure all changes to an already accepted system is Government approved prior to implementation.
- Any changes required of a contractor management system to meet the C/S criteria will be made at the contractor's expense.
- When set forth in a contract (mutual agreement between the Government and the prime contractor), selected subcontractors under the prime contractor's control will meet C/SCSC standards to include all provisions regarding system review, demonstration, and surveillance. (C/SCSC JIG, 1987)

In addition to the above clause, the management tasks need to be defined in the Statement of Work (SOW), the WBS must be defined for the effort, and the Contract Data Requirements List (CDRL) must be generated and placed in the RFP by the PCO.

b. Statement of Work (SOW)

The SOW is the requirement statement for the RFP. It identifies to the contractor the required contractual tasks. For example, the SOW will address several contract aspects, such as contract line items, configuration items, contract work statement, and the contract specifications (Nash,

Cibinic, 1993). The SOW should state management requirements in terms of results rather than "how to manage" procedures. Language in the SOW defining the scope or limits of the contractor's effort is of critical importance. If the SOW requirements are poorly stated, it will be difficult to determine if or when there has been a change in scope. Some examples of SOW language for inclusion of C/SCSC tasks in the RFP are the following:

- Contractor Cost and Schedule Reporting.
The contractor will provide periodic reports detailing the integrated cost and schedule status of work progress on the contract. The contractor will relate technical accomplishment with cost and schedule accomplishment in contract performance reports and meetings. The report's format and contents will conform with the CDRL.
- Subcontractor Cost and Schedule Reporting.
Integrated cost and schedule reporting is required on subcontracts that, based on risk, schedule criticality or dollar value, have the potential to impede the successful completion of the prime contract. The Government and the contractor will agree on which subcontracts will be selected for integrated cost and schedule reopening. (Draft Cost/Schedule Management Guide (version G), 1995)

c. Contract Work Breakdown Structure (CWBS)

The contract work breakdown structure (CWBS) is the complete WBS for a contract and is very important to the effectiveness of an integrated management control system. It is the format by which all costs and schedule developments are tracked and reported (Fleming, 1983). The CWBS drives the cost

of implementing and maintaining an integrated management control system on a project (Clark, 1995). Therefore, the PCO should exercise considerable care in its development and inclusion in the RFP.

Generally, CWBS reporting levels to the Government should be limited to level 3 (see figure 2), except for high-cost or high-risk lower level elements. Contract line items should be included as separate WBS elements and the WBS should be aligned with the SOW to the maximum possible extent. The PCO and the contractor should carefully evaluate the CWBS reporting levels selected for routine reporting to ensure only the minimum information necessary for effective management control is obtained. Reporting levels should be evaluated periodically and changed, if necessary, to ensure they continue to satisfy management's needs. (Draft Cost/Schedule Management Guide (version G), 1995)

d. Contract Data Requirements List (CDRL)

The Contract Data Requirements List (CDRL) provides report preparation guidance, including reporting frequency, distribution and tailoring instructions. Cost and Schedule variance thresholds are defined in the CDRL for the CPR. The PCO should carefully evaluate the information needs and require only an amount that is needed for effective management control as determined by the program manager. Excessive

variance explanations can diminish the usefulness of the CPR and add cost to the contract (Schiller, 1991). It is important for the PCO to recognize that CPR frequency, formats, reporting levels, and variance analysis thresholds are all subject to negotiation; and any needed adjustments in these areas may be proposed by either party during this phase of the contracting cycle (Manzer, 1996).

3. Source Selection

Selecting the proper contractor is one of the PCO's most important tasks. An unqualified or unreliable source will jeopardize the success of the program, regardless of how well the contracts are written or how efficient the Government acquisition team is. (Pugh, 1985)

A Source Selection Plan (SSP) should be prepared by the PM, reviewed by the PCO, and approved by the Source Selection Authority (SSA) before issuance of the solicitation (Nash, Cibinic, 1993). During the proposal evaluation process, the PCO must ensure that decisions are supported by a thorough and integrated assessment of all relevant information.

The Federal Acquisition Regulations (FAR) requires that R&D contracts be awarded to those organizations "...which have the highest competence in the specific fields of science or technology involved" (FAR, 1993). This implies that the PCO, as a key advisor to the SSA, must determine the contractor's

understanding of the program and the ability to organize and perform the contract.

Section 52.242-7001 of the DOD supplement to the FAR (DFAR) directs the contractor to submit a "comprehensive plan for C/SCSC." The plan helps the Source Selection Evaluation Board (SSEB) in determining if the contractor understands the criteria, in that the plan must show how the contractor's performance measurement system satisfies the C/SCSC requirements. However, there is disagreement on how much detail the plan must include. Some feel that the plan should explain how every one of the criteria is satisfied, while others believe that simply providing enough explanation to demonstrate that the contractor understands the 35 criteria is sufficient (Pugh, 1985). Since a PCO is usually not an expert in this field, he or she must rely heavily on the SSEB in determining whether or not the contractor's proposed systems description adequately describes compliance with the criteria. Nevertheless, the PCO should have a sound understanding of the key criteria disciplines, such as CWBS planning, establishment of the PMB, and earned value reporting. This will help to ensure that these critical areas are included in the RFP and the contract.

The importance of carefully evaluating the contractor's performance measurement system in source selection cannot be

over emphasized. Regulations require C/SCSC, as it helps both the government and the contractor manage the program better. The Government wants to receive performance measurement information early in the program so that problems can be identified and corrected before a situation becomes critical. If a contract is awarded to a contractor who has an inadequate plan for C/SCSC, performance measurement may be inadequate and the information provided to the government may be a distortion of the actual conditions.

a. *Proposal Elements*

As specified by the RFP, the contractor submits his proposal as a set of volumes. Each volume contains information that is needed for a formal proposal evaluation and each is subdivided into areas. Normally there are five areas: Technical Capability, Production Capability, Readiness Support/Life Cycle Cost, Past Performance, and Program Management. (Nash, Cibinic, 1993)

These areas are subdivided into items. It is not unusual to have 8-10 items in each area. Each item is further divided into factors. In some rare instances, the factors are broken down into subfactors. The proposal is thus subdivided into smaller elements to allow for simpler and more precise evaluation of the proposal.

The criteria are typically evaluated at the factor level and are normally located under the Management, Planning, and Organization item in the Program Management area. Other factors in this item usually include Organizational Responsibilities, Management Information System, Work Breakdown Structure, and Schedule. (Pugh, 1985)

b. Proposal Evaluation

Normally, a new program C/SCSC Evaluation Review is accomplished as part of precontract award procedures. It is the process of evaluating proposed or existing systems and methods by which the contractor plans to comply with the criteria. The review includes use of applicable parts of the Evaluation/Demonstration Review Checklist found in Appendix E of the JIG. (C/SCSC JIG, 1987)

If a contractor has proposed to use a previously accepted system, the cognizant ACO and resident DCAA auditor are required to furnish a report stating whether or not the contractor's system still meets the criteria (C/SCSC JIG, 1987).

Following the Evaluation Review, a written report is prepared by the Evaluation Review team which will attest whether or not the contractor's system description in the proposal adequately describes compliance with the criteria.

If not, the report must identify specific deficiencies. This report is provided to the PCO. (C/SCSC JIG, 1987)

Although C/SCSC is only a small part of the overall proposal, it is nevertheless a contract requirement. When the contractor's comprehensive plan for C/SCSC is poor, and the SSEB feels that there will be difficulty making the system acceptable, the PCO should seriously consider removing the contractor from competition and recommending non-selection to the SSA.

C. POST AWARD ACTIONS

1. Surveillance: Phase I

The next step in the C/SCSC implementation process involves the validation or verification of the contractor's management control system. Validation represents phase I of the C/SCSC surveillance process that begins after the award of the contract and continues through system demonstration and acceptance. The validation process includes a series of reviews conducted by a Government review team made up of selected representatives from the program office and DCMC [Fleming, 1983]. Although the PCO is normally not a member of the review team, his or her involvement may occur if contract changes are necessary to obtain a fully compliant system. Therefore, the PCO must become familiar with the mechanics of

the validation and surveillance process, so that contractual issues arising from C/SCSC reviews can be resolved in an efficient and effective manner.

In accordance with the C/SCSC Joint Surveillance Guide, the objectives of C/SCSC surveillance are two-fold. First, it must ensure that the contractor's management control system

- Provides valid and timely management information,
- Complies with the DOD Cost/Schedule Control Systems Criteria,
- Provides timely indications of actual or potential problems, and
- Provides baseline integrity.

Second, it should ensure that the contractor's required external cost and schedule reports

- Contain information that is derived from the same data base as that used by contractor's management,
- Contain explicit and comprehensive variance analyses including proposed corrective action in regard to cost, schedule, technical, and other problem areas, and
- Contain information that depicts actual conditions. (C/SCSC Joint Surveillance Guide, 1984)

There are varying degrees of validation reviews, depending upon whether the awarded contractor has a previously accepted C/SCSC system. Contractors who have a previously accepted system will usually exercise the Advance Agreement

(AA), which states the contractor's agreement to use and maintain accepted management control systems on the current as well as future contracts which require compliance with the C/SCSC. The AA also documents the Government's intent to minimize system reviews (DODI 5000.2, 1991). Based on this and any previous experience with the awarded contractor, the ACO together with the team chief will determine the type of review process to be used. Contractors who have a previously accepted system can expect to undergo a Subsequent Application Review (SAR) or an Extended Subsequent Application Review (ESAR). (C/SCSC JIG, 1983)

SAR is a more informal review and is usually short in duration (3 to 5 days). It is performed in lieu of a Demonstration Review (to be discussed subsequently). The purpose of SAR is to ensure that, on a new contract, the contractor is properly and effectively using the accepted system, revised in accordance with approved changes. It is not intended to reassess the previously accepted system. (C/SCSC JIG, 1983)

The ESAR can also be applied to a contractor who has had a previously accepted system. The ESAR differs from the SAR in that it is more formal and usually requires about 10 days to complete (Coutteau, 1992). An ESAR is appropriate in these cases:

- A program moved from one phase to another (e.g., R&D into production)
- A contractor moved an existing program from one facility to another.
- A contractor made substantial changes to an approved C/SCSC system description or procedures. (Fleming, 1983)

As with the SAR, a contractor who is designated to receive an ESAR should expect to be ready within 90 days after contract award.

For a contractor who does not have a previously accepted C/SCSC system, a different set of review actions occurs. Upon award of a contract requiring C/SCSC, the contractor can expect to receive an Implementation Visit (IV), which is a preliminary review, followed by a Readiness Review (RR). Finally, when ready, the contractor will undergo a Demonstration Review to validate his system. (Coutteau, 1992)

As soon as possible after contract award, preferably within 30 days, representatives of the C/SCSC review team should visit the contractor's plant and review the contractor's plans for implementation of C/SCSC. Areas of noncompliance or potential problems will be identified [Kemps, 1978]. This visit provides an early dialogue between the procuring activity and the contractor relative to the C/SCSC review process in order to clarify any misinterpretations.

During this preliminary review, the contractor will usually make presentations to reflect the design and operation of the system and explain applicable reports. The team will examine selected documents and procedures proposed by the contractor and identify any deficiencies. Lastly, during this visit, a schedule will be established for follow-on readiness assessment and full-scale demonstration review. (C/SCSC JIG, 1987)

The Readiness Review involves a series of meetings between the Government Demonstration Review Team and the contractor. It usually occurs 30 days after the implementation visit and lasts 3 to 5 days. The purpose of the Readiness Review is to accomplish the following:

- Determine system readiness for a fully integrated management system.
- A mini demonstration review in preparation for the full-scale Demonstration review.
- Familiarize Government Review Team with the fundamentals of the contractor's systems
- As with the Implementation Visit, identify for correction any deficiencies, and clear-up any misunderstandings.
- Require corrective action plans and establish Demonstration Review dates. (C/SCSC JIG, 1987)

The Demonstration Review is the most detailed and intensive of all the reviews. The Demonstration Review team examines pertinent working papers and documents associated

with the contractor's management control systems, such as budgeting, work authorization, accounting and other functional documents, to ascertain compliance with the criteria. Additionally, the team conducts level-of- knowledge interviews with contractor personnel who are directly involved with the operation of the management control systems (i.e., program manager, functional managers, cost account managers, schedule manager etc.).

At the conclusion of a Demonstration Review, a formal report is prepared and submitted to the review director and the PCO by the team members within 15 days after completion of the review. Upon receipt of the report, the PCO will inform the contractor regarding the acceptance or nonacceptance of its system (Sweeney, 1992). If the contractor's system is not acceptable, the review director must clearly identify areas to be reexamined; and a schedule for developing solutions and for subsequent Demonstration Review will be agreed upon by the contractor and the PCO (C/SCSC JIG, 1987).

When a contractor successfully passes the demonstration review, a system description document is updated to reflect the accepted management control system and it becomes a part of the contract. The contractor is then contractually obligated to maintain the management control system in accordance with the accepted system description. Successful

demonstration of the contractor's management control system generally results in a tri-Service acceptance that remains in effect as long as the system continues to meet the criteria (C/SCSC JIG, 1987). Figure 5 on the following page illustrates the flow of events discussed above.

2. Surveillance: Phase II

Following the Demonstration Review and acceptance of a contractor's management control system, the second phase of C/SCSC surveillance starts with the formalization of the establishment of a Memorandum of Agreement (MOA) and the formalization of a Surveillance Plan. (Coutteau, 1992)

MOA is a negotiated agreement that establishes and describes in general terms the responsibility and relationships between the procuring activity and CAO relative to C/SCSC surveillance. The provisions of the MOA will vary depending upon circumstances such as the Military Department involved, CAO resources, and the desires of the procuring activity. In developing and executing the MOA, the PCO should ensure that there is no duplication of responsibilities and functions and, more importantly, that the MOA provides a means for resolving problems and promoting better communications. The MOA should be updated as needed, but at least annually. (C/SCSC Joint Surveillance Guide, 1984)

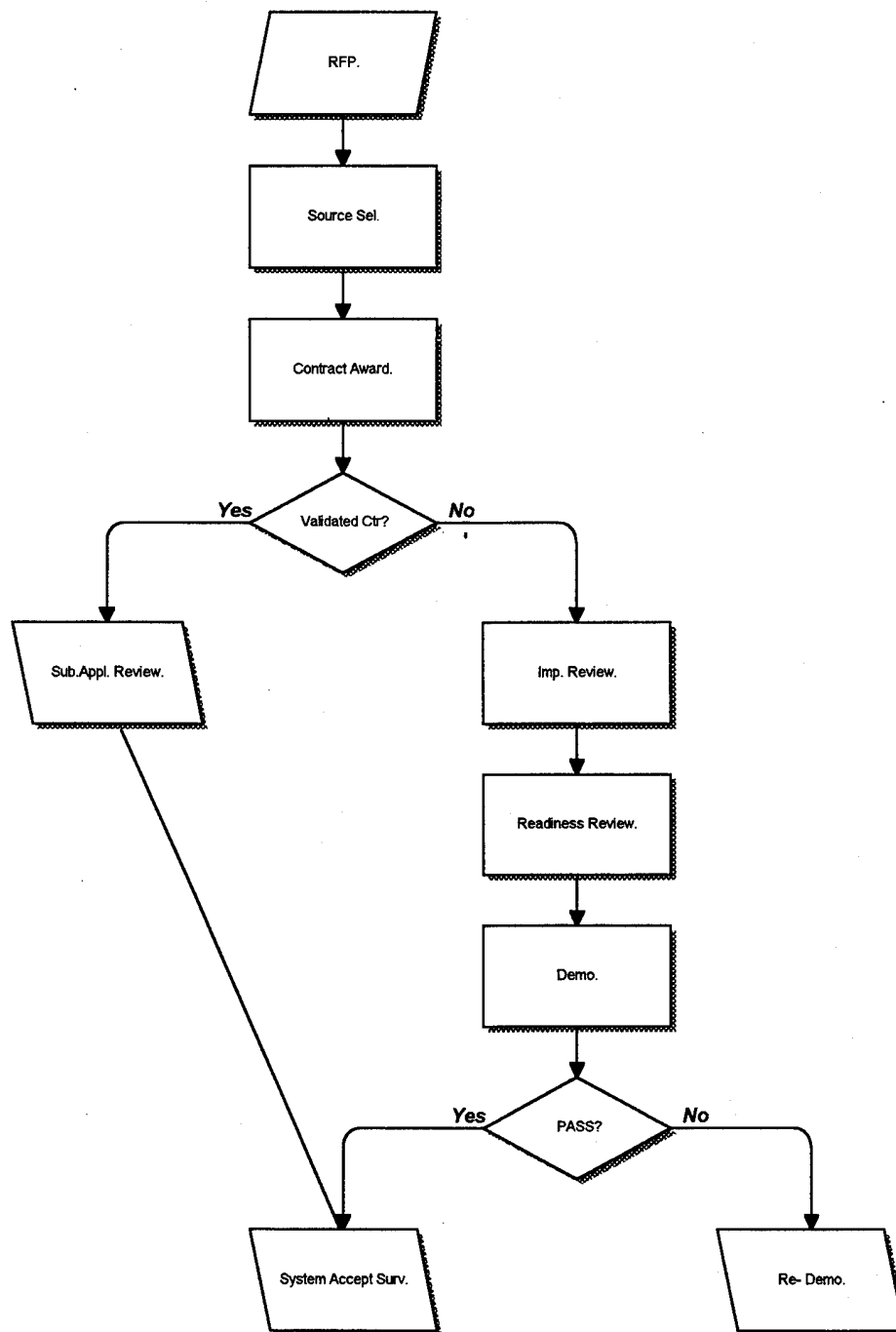


Figure 5. C/SCSC Implementation Process

In consonance with the MOA, the PCO works with the CAO in preparing a Surveillance Plan that will be followed by the surveillance personnel. The Surveillance Plan augments the MOA. It is the plan that describes how the CAO, with DCAA participation, will carry out the C/SCSC surveillance responsibilities as agreed in the MOA. Primary considerations in the design of the Surveillance Plan are the specific contractor management control system being evaluated, the contractual requirements, the degree of program risks, the desires of the procuring activity, and the availability of personnel. This plan should be submitted to the PCO for concurrence and to the PM for approval, and it should be implemented as soon as possible after a Demonstration or Subsequent Application Review. Surveillance functions defined in FAR 42 and DOD FAR Supplement 242 may be added to the Surveillance Plan and reflected in the MOA when agreed upon by the CAO and the PCO. (C/SCSC Joint Surveillance Guide, 1984)

D. CHAPTER SUMMARY

Chapter III examined the role of the PCO during different phases of the contract and his or her interface with the contractor and other Government personnel in the implementation and surveillance of C/SCSC. The importance of the PCO is readily apparent throughout this process, as he or

she is the sole Government agent with the authority to issue solicitations, conduct negotiations, and enter into a contract. This chapter outlined the actions that need to be taken by the PCO to ensure an adequate program is established that will provide timely, and accurate contract cost and schedule information. Pertinent topics discussed include C/SCSC elements of the RFP, evaluation of contractor's proposal, a description of various validation reviews, and the two phases of C/SCSC surveillance.

Chapter IV will focus on current C/SCSC policy and technological developments that are consistent with acquisition reform initiatives. Specific areas that will be addressed include Integrated Baseline Review (IBR), Electronic Data Interchange (EDI), and Integrated Product Team (IPT).

IV. CURRENT DEVELOPMENTS IN C/SCSC

A. CHAPTER INTRODUCTION

When C/SCSC was under the auspices of the DOD comptroller and governed by the financial regulatory document DODI 7000.2, the majority of industry and Government program managers treated C/SCSC as a financial requirement rather than as a program management tool. In an effort to change this cultural mind set, the organization responsible for C/SCSC policy was transferred from the DOD Comptroller to the Under Secretary of Defense (Acquisition) in 1989. Soon afterward, C/SCSC guidance also moved from DODI 7000.2 to DODI 5000.2. (Abba, 1995)

Change came slowly, however, and it took a series of major acquisition disasters, attributed largely to inadequate cost management, to focus attention on earned value management. Each Service has at least one example. Cost problems in the Army AAWS-M, Navy A-12, and Air Force C-17 programs were all shown to have been foreseeable, if not avoidable, using earned value reports from the contractors' C/S management control systems. Consequently, DOD and Service executives began to emphasize that C/SCSC and earned value are an integral part of program management. (Abba, 1995)

In his keynote address at the Seventh Annual International Cost and Schedule Performance Management

Conference, the Under Secretary of Defense for Acquisition and Technology, Dr. Paul Kaminski reaffirmed that the earned value management process remains the DOD's tool of choice for managing large, risky contracts. However, he also emphasized that "there is still more room for improvement in the way that earned value process is implemented and applied." (Kaminski, 1995) This chapter will discuss several current C/SCSC initiatives that were mentioned by Dr. Kaminski in his speech. These initiatives, which are consistent with the objectives of Acquisition Reform, represent positive steps toward needed improvements in earned value management.

B. MODEL PROGRAM APPROACH

One of the responsibilities of Gary Christle, Deputy Director of Performance Management within the OUSD(A&T), is the formulation of DOD policy for the C/SCSC. In his role, Christle must not only deal with the day-to-day issues, but he also must lead the earned value community into the future-- a future that is significantly different because of the rapidly evolving defense acquisition environment. At the October 1993 C/SCSC Conference, Christle presented his "vision statement" for the future of this discipline. The central theme behind Christle's vision is that "the quality of a contractor's management system is determined not by the absence of defects,

but by the presence of management value." (Christle, 1993) With this idea in mind, he outlined a "Model Program" approach for earned value management that would require little, if any, policy change. The main objectives of the Model Program approach are as follows:

- Change the emphasis from the Government to the contractor. C/SCSC compliant systems should represent how the contractor manages. The mere act of awarding a contract should not trigger a government review. Review should be conducted only for cause.
- Reduce the review burden on both the Government and contractor, and emphasize the presence of value in the management systems, rather than the absence of deficiencies.
- Put earned value in its proper context as an integrating tool for cost, schedule, and technical management.
- Limit reporting to what can and will be effectively used.
- Ensure early and comprehensive planning, to establish common understanding of the task by both parties. (Christle, 1993)

Christle and his staff have been working to implement this vision through several initiatives. The rest of this chapter will examine some of these initiatives in detail.

C. INTEGRATED BASELINE REVIEW

The impetus for the Integrated Baseline Review (IBR) requirement was the 1993 DOD Inspector General (DODIG) audit. This audit focused on the use of C/S performance data by nine

acquisition category (ACAT) I programs (three from each Service). Despite the importance of a baseline for effective contractor performance measurement, over half the programs reviewed were found to have unrealistic baselines that do not represent the true cost or amount of work needed to complete the contract (DODIG Audit Report No. 93-067, 1993). Acting on the recommendations of the audit report, the Principal Deputy Under Secretary of Defense, issued a memorandum to all Component Acquisition Executives (CAEs) directing an immediate implementation of IBR (Longuemare, January 1994). The memo directs an IBR on all new contracts that require C/SCSC compliance.

The draft Cost/Schedule Management Guide (version G) addresses IBR in detail, and provides the following definition:

An IBR is a formal review conducted by the Government PM and technical staff following contract award to verify the technical content of the performance measurement baseline. An IBR may also be performed when work on a production option of a development contract begins, when a major modification of an existing contract significantly changes the existing PMB or, at the discretion of the program manager. (Draft Cost/Schedule Management Guide, 1995)

The intent of the IBR is to institute a process that allows the Government PM and technical staff to be involved in managing the program using performance measurement information. The specific objectives of an IBR as outlined by

Tony Finefield, the focal point for the rewrite of the Joint Implementation Guide are as follows:

- To ensure that the technical content of work packages and cost accounts is consistent with the contract scope of work, the CWBS, and (if applicable) CWBS dictionary.
- To ensure that there is a logical sequence of effort planned consistent with contract schedule.
- To assess the validity of allocated cost account and summary level planning package budgets, both in terms of total resources and time-phasing.
- To conduct a technical assessment of the earned value methods that will be used to measure progress to assure that objective and meaningful performance data will be provided.
- To establish a forum through which the Government program manager and the program technical staff gain a sense of ownership of the cost/schedule management process. By understanding the internal earned value management system, Government and contractor technical counterparts can jointly conduct recurring reviews of (PMB) planning, status, and estimates at completion to ensure that baseline integrity is maintained throughout the life of the contract. (Finefield, 1995)

Ideally, the IBR should be conducted in conjunction with the Readiness Assessment Review. However, as a matter of policy, the IBR is required to be conducted within six months after contract award. The review is conducted at the prime contractor's facility and should normally take no longer than three days. The duration, however, should be based on the size of the contract, the number of cost accounts to be reviewed,

number of contractor managers to be interviewed, and other factors. There is no formal report at the conclusion of the IBR. The contractor will receive either a letter acknowledging successful accomplishment of the review or notification of the findings, with an expectation that they will be satisfactorily resolved, in a timely manner, through the surveillance program. Successful completion of IBR should mitigate the requirement for subsequent C/SCSC reviews, but is not intended to be a substitute for such reviews. (Draft Cost/schedule Management Guide, 1995)

D. INTEGRATED PRODUCT PROCESS DEVELOPMENT AND INTEGRATED PRODUCT TEAM

At the forefront of the Acquisition Reform movement are two management concepts borrowed from industry: Integrated Product and Process Development (IPPD) and Integrated Product Teams (IPTs). Both the SECDEF and the USD(A&T) have mandated the immediate use (to the maximum extent practicable) of both IPPD management techniques and IPTs throughout the acquisition process.

In the SECDEF memo of 10 May 1995, an IPPD is defined as

. . . a management technique that simultaneously integrates all essential acquisition activities through the use of multidisciplinary teams to optimize the design, manufacturing and supportability processes (Perry, 1995).

At the core of IPPD implementation are Integrated Product Teams (IPTs) that carry out the mission of the organization (DOD Guide to IPPD, 1996). IPTs are composed of representatives from all appropriate functional disciplines working with a team leader to build successful and balanced programs, identify and resolve issues, and make sound and timely decisions. Thus, IPT is a key aspect of the IPPD management approach. In the USD(A&T) memo of 28 April 1995, the objectives of forming an IPT within OSD and the Service acquisition staff were laid out as follows:

- To create an acquisition system that capitalizes on the strengths of all participants in the acquisition process to develop programs with the highest opportunity for success.
- To foster early, active and constructive participation of OSD and Component staff organizations with program office teams to develop a sound, executable acquisition strategy.
- To identify and resolve issues as they arise, not during or just prior to the final decision meeting.
- To transform historically adversarial relationships, especially between headquarters staff organizations and program office teams, into productive partnerships.
- To renew emphasis on the importance of working as a cross-functional team to maximize overall performance. (Kaminski, 28 April 1995)

Depending on their function and role in the acquisition process, IPTs are categorized into four types (see Figure 6).

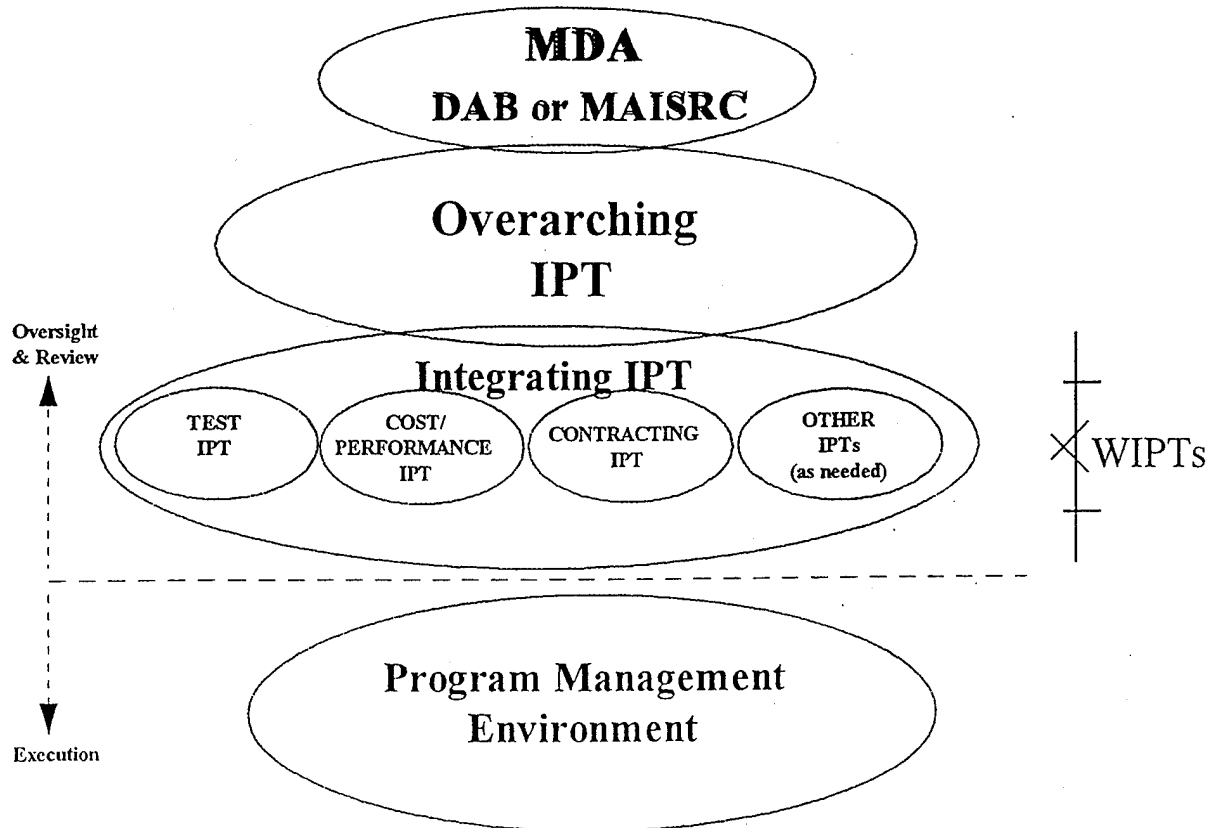


Figure 6. Integrated Product Team Structure.
Ref. (DOD Guide for IPT, 1995)

Overarching IPT (OIPT) provides structure, strategic guidance, and oversight to functionally oriented IPTs. The Working-Level IPT (WIPT) focuses on a particular functional area, such as test, cost/performance, contracting, etc. The integrating IPT coordinates WIPT efforts and covers areas not specifically assigned to another IPT. Lastly, the Program IPT manages and executes the complete scope of the program, and reports program status and issues to the oversight and review IPTs. Users, program managers, functional managers and acquisition management staff should be represented in IPT along with

contractors and suppliers to achieve the full potential of IPPD. (DOD Guide for Leading Successful IPTs, 1995)

IPTs have become a preferred process for monitoring C/S performance on major DOD acquisition programs. A good example of successful integration of earned value management with the IPT concept is the F/A-18 program. F/A-18 is a large multi-billion dollar Navy ACAT ID program that is organized into smaller programs, each managed by an IPT. Each of the IPTs develops cost, schedule, and technical baselines and is required to manage within the stringent constraints of these baselines. To facilitate effective management of these baselines, IPTs extensively use earned value data. The data are used as a management tool, as well as an indicator of program status. Thus, performance measurement plays a significant role in the day-to-day functioning of this IPT-oriented program.

According to the DOD Guide to IPPD, successful IPPD implementation can result in the following benefits to DOD and contractors:

- Reduced overall time to deliver an operational product. Decisions that were formerly made sequentially are now made concurrently and from an integrated perspective. These decisions are based on life cycle perspective and should minimize the number and magnitude of changes during manufacturing and eventual operational deployment of the product. This in turn reduces late, expensive, test-fix and

test-redesign remanufacture cycles that are prime contributors to schedule extensions.

- Reduced system (product) cost. Increased emphasis on IPPD at the beginning of the development process impacts the product/process funding profile. Specifically, funding profiles based on historical data may not be appropriate. Some additional funds may be required in the early phases, but the unit costs as well as total life cycle costs should be reduced. This will be primarily due to reduced design or engineering changes, reduced time to deliver the system and the use of trade-off analysis to define cost-effective solutions.
- Reduced Risk. Up-front team planning and understanding of technologies and product processes permits better understanding of risk and how it impacts cost, schedule and performance. This understanding can result in methods or processes for reducing or mitigating assumed risks and establishing realistic cost, performance and schedule objectives.
- Improved quality. Teamwork coupled with a desire for continuous improvement results in improved quality of the processes and a quality product for the user. (DOD Guide to IPPD, 1994)

E. ELECTRONIC DATA INTERCHANGE (EDI)

The DOD 5000.2-M, Part 20, includes a statement encouraging the use of electronic data interchange (EDI) for cost performance reporting. The DOD defines EDI as a direct computer to computer exchange of readable and processable business or technical information using a public standard. For

C/S reporting, American National Standards Institute (ANSI) X12 compliant transaction sets 806 (project schedule reporting) and 839 (project cost reporting) are the public standard.

As mentioned in Chapter II, the Performance Analyzer (PA) version 4.0 contains an EDI module. With this capability now available, the USD(A&T) directed all Component Acquisition Executives (CAE) in a memorandum dated January 25, 1995, to use EDI on all new contracts that require submission of CPR, CCDR and C/SSR (Kaminski, January 1995).

To the Government, the benefits of using EDI for C/S reporting are as follows:

- Accelerated receipt of time-sensitive data
- Standardized format for C/S performance reporting
- Elimination of data entry process
- Automated analysis (PA or other tools)
- Reduction of administrative costs
- Development of historical data base

Similarly, contractors benefit from using EDI for C/S reporting through reduced administrative procedures and costs; however, the greatest incentives to contractors are in other EDI applications, such as billing and procurement orders.

Currently, the Naval Sea Systems Command (NAVSEA) is the lead activity within DOD for prototyping EDI for CPRs. Figure

7 illustrates how EDI is implemented at NAVSEA and how it interfaces with the Navy's Early Warning System (EWS). The Assistant Secretary of the Navy (ASN(RD&A)) established the requirement for the EWS in 1992 to provide summary cost performance data to Navy acquisition managers. EWS is intended to place early management focus on cost performance analysis indicators and their underlying issues (Chen, 1996).

In August 1995, a Program Management Working Group was established to coordinate and assist DOD efforts toward full EDI implementation of program C/S performance reporting. All DOD components, OSD and the Defense Information Systems Agency (DISA) are represented in the Group. The Group is currently working to resolve such problems as the development of a

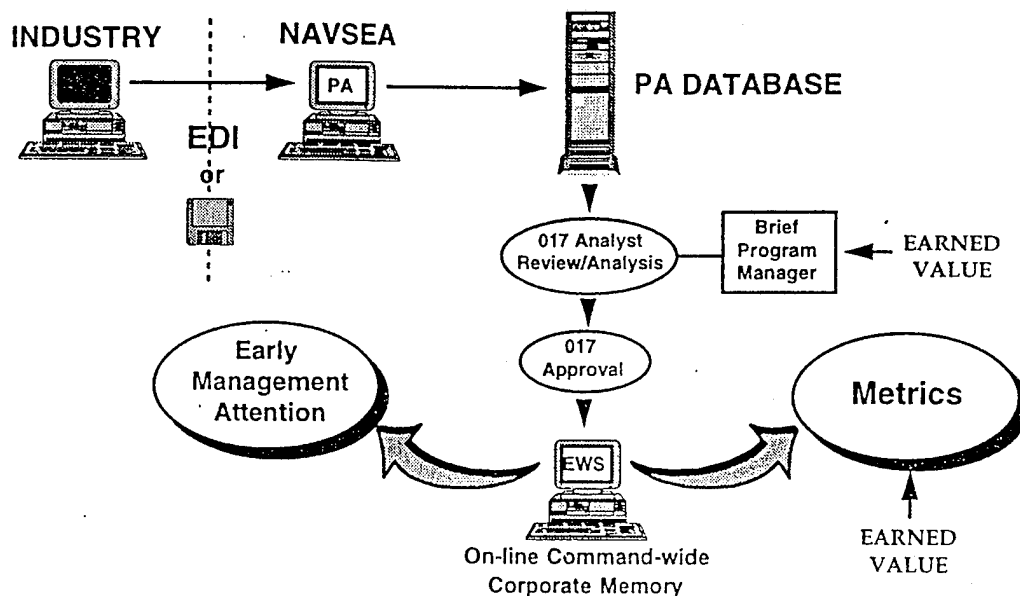


Figure 7. EDI and EWS data flow
Ref. (NAVSEA (017), 1995)

uniform policy/guidance for implementation, security concerns over electronic transmission of business-sensitive data, and unreliable telecommunications support structure. According to the Group leader and Branch Manager for C/SCSC at NAVSEA (Code SEA-017), Yacoub Mourab, the Group's main goals are to:

- Assist the Services in establishing an EDI prototype effort and make the transition to full implementation.
- Provide appropriate training to those involved in the EDI process.
- Create, obtain approval of, and maintain implementation conventions and transaction sets.
- Coordinate the Group's efforts with other working groups and agencies involved in EDI efforts. (Yacoub, 1996)

In short, C/S performance reporting via EDI is achievable. However, some pertinent issues must still be resolved before it can be fully implemented throughout the DOD. Despite these unresolved issues, C/S reporting via EDI has now become mandatory on all new major contracts requiring compliance with C/SCSC.

F. C/SCSC INDUSTRY STANDARD

The International Organization for Standardization (ISO), is a nongovernment organization headquartered in Geneva, Switzerland. Its purpose is to foster the development of

uniform quality standards and procedures. Such uniformity is designed to facilitate the international exchange of goods and services and to promote cooperation and intellectual, scientific, technological, and economic activity (ISO, 1992). ISO has a membership comprised of national standards bodies from more than one hundred countries. The American National Standards Institute (ANSI) represents the United States. (Berzazzani, Steer, 1995)

ISO standards are intended to be voluntary and industry-wide, and they are aimed at satisfying industries and customers on a global basis. ISO 9000 is a series of quality standards developed to meet customers' quality assurance requirements. The series consists of five core standards: three quality assurance models for specific environment(s) and two documents that give generic guidelines. Figure 8 shows the interrelationships of the documents that comprise the ISO 9000 standard series.

Recognized as an international benchmark for measuring quality, the series is built around the definition of "quality" as an organization's ability to consistently deliver a product or service that fulfills customer requirements. Its aim is to prevent nonconformity (i.e., nonfulfillment of specified requirements) at all stages, from design through

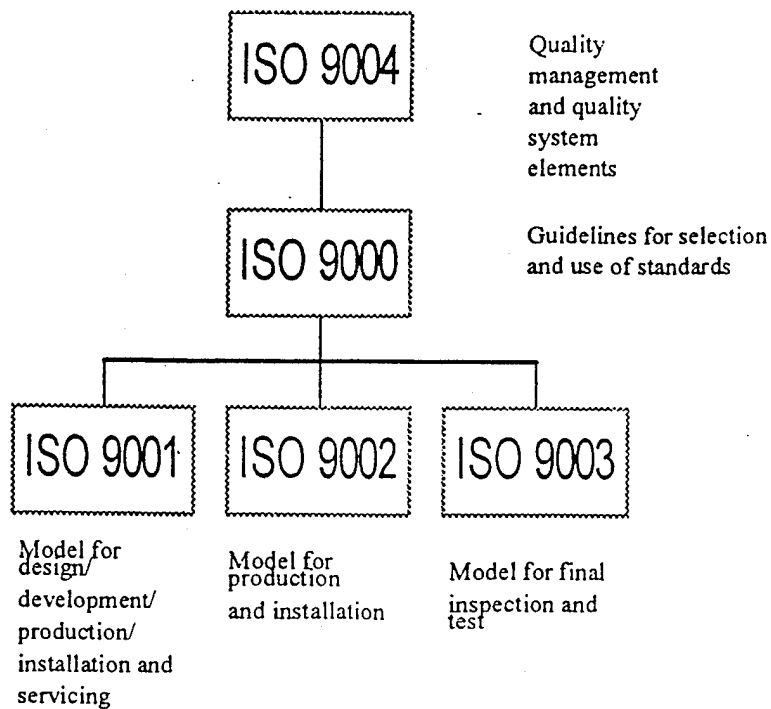


Figure 8. ISO 9000 Standard Series
Ref. (Cukr, 1995)

servicing. ISO 9000 requires adequate quality systems, objective evidence of the fulfillment of every requirement, complete controlled documentation, and periodic surveillance audits. (Bernazzani, Steer, 1995) DOD has recently embraced ISO 9000. In February 1994, the DOD authorized its use in contracts for new programs (McGovern, 1994). Additionally, because of the many similarities between ISO 9000 and C/SCSC, there is a strong movement toward establishing an industry or international standard for C/SCSC along the lines of ISO 9000. In a persuasive article, Anita Cukr compared and contrasted the key management precepts of C/SCSC and ISO 9000 and

concluded that C/SCSC are basically DOD's version of ISO 9000, tailored to the unique needs of the DOD market and product. She specifically noted that the ISO standard most similar to C/SCSC is ISO 9004, which gives guidelines for quality management and quality systems. Some observations that Cukr made to support her assertions are as follows:

- Both ISO 9000 and C/SCSC are standards for running a business well, and both refrain from mandating specific methods or techniques.
- Both ISO 9000 and C/SCSC require businesses to document their own management procedures. ISO 9000 requires a business to manage in accordance with its own documented requirements of the standard. The C/SCSC require a "system description" that describes the management system and explains how it meets the standards.
- ISO 9004 requires management to provide sufficient and appropriate resources to achieve quality objectives. The C/SCSC subsection entitled Planning and Budgeting deals with allocation of resources in accordance with the company's needs to produce the good or service at a given price in an agreed-to period, and meeting the quality specifications of the contract.
- ISO 9004 requires clear definition of general and specific responsibilities and authority. The C/SCSC subsection entitled Organization deals with same issues.
- A firm can register to ISO 9000 after an accredited third-party registration body certifies that the firm's quality system conforms to the standard. Firms doing significant business with DOD, that require the application of C/SCSC to their management system, must submit to an audit by DOD. The intent of the audit is to certify the firm's

system as compliant with the standards. With the C/SCSC, as with ISO 9000, certification has implications for the firm's competitiveness. (Cukr, 1995)

On September 9, 1994, R. Noel Longuemare, the Principal Deputy Under Secretary of Defense (Acquisition and Technology), sent a memorandum to James Hogg, president of National Securities Industrial Association (NSIA). Longuemare proposed that industry work with Government to establish an industry or international standard for integrated cost, schedule and technical performance management along the lines of the ISO 9000 quality system standard. Hogg responded affirmatively in a speech given at the International Cost/Schedule Performance Management Conference in October 1994. Dr. Kaminski reaffirmed the proposal in his January 5, 1995 memorandum to the NSIA, Aerospace Industries Association, and Electronic Industries Association. (WWW, February 1996)

G. CHAPTER SUMMARY

The intent of this chapter was to give the PCO a brief update on some pertinent developments in C/SCSC. It must be realized that C/SCSC has undergone a major transformation during the past decade. It is no longer perceived to be a nonflexible, highly proceduralized, financial requirement, but rather an indispensable program management tool used for integrating cost, schedule, and technical performance.

However, as Dr. Kaminski pointed out, there is still room for improvement, and recent initiatives such as IBR, IPPD/IPT, EDI, and ISO 9000 have all helped to improve the implementation and use of earned value principals.

Chapter V, will provide answers to the research questions, and, in doing so, summarize the key points contained within the main text of this thesis. The chapter will also present two recommendations based on conclusions drawn from this research.

V. SUMMARY, RECOMMENDATIONS AND CONCLUSION

The research questions posed in Chapter I will be answered in this chapter. In doing so, the key points covered in the main text will be summarized for emphasis. This chapter also contains the researcher's recommendations and conclusion generated from this study.

A. ANSWERS TO RESEARCH QUESTIONS

1. Primary research question:

What should the procuring contracting officer (PCO) understand to successfully implement and administer C/SCSC in major acquisition programs?

First and foremost, the PCO needs to understand that the C/SCSC does not prescribe a uniform system. Rather, it simply specifies minimum standards that a contractor's management control system must meet in order to satisfy the Government's need for timely, auditable data that can be used to determine contract status. The PCO must be careful not to over-apply the criteria when preparing the RFP, evaluating proposals and conducting negotiations. Over application of the criteria imposes unnecessary administrative burden on the contractor and financial expense on the Government. A detailed cost-benefit analysis of each C/SCSC requirement should be

performed prior to issuing the RFP to avoid imposing non-value added requirements.

Secondly, the PCO should be thoroughly aware of the procuring activity's needs and desires for cost and schedule visibility, so that the appropriate contractual clause, SOW, WBS, and CDRL can be included in the RFP and the subsequent contract. Additionally, the PCO should keep in mind that, although the criteria are not subject to negotiation, reporting aspects of C/SCSC, such as the CPR formats, analysis level, submission frequency, and variance threshold can be tailored to meet specific program needs. Tailoring minimizes cost, and maximizes the utility of the C/SCSC data. In implementing C/SCSC, the principal guideline should be to do what makes sense.

Third, the PCO must have a good understanding of the earned value concept and be familiar with the different types of reports generated through the C/SCSC process. Possessing the ability to analyze and interpret cost and schedule performance data will allow the PCO to make better contractual decisions and become a more effective member of the integrated product team (IPT).

Fourth, the PCO needs to understand that C/SCSC post-award activity consists of two separate phases--system demonstration and acceptance (Phase I) and surveillance (Phase

II). Because C/SCSC validation reviews are generally complex, time consuming, and manpower intensive, understanding the purpose and scope of the various reviews is critical during Phase I. Proactive PCO involvement is required to develop and establish an effective surveillance plan with the cognizant CAO during Phase II.

The PCO does not need an in-depth knowledge of all 35 standards or criteria to successfully implement and administer C/SCSC in major acquisition programs. The criteria are conceptually simple and consistent with sound business practices. Perhaps that is why C/SCSC have endured the test of time and remain the primary tool for monitoring and controlling the vast expenditures of public funds on DOD acquisitions.

2. Subsidiary question #1.

What is the main product of the C/SCSC process, and why is it useful to the DOD and to the procuring activity in particular?

The summary data generated by the contractor's C/SCSC compliant system are reported to the Government through the cost performance report (CPR). The CPR has five formats that contain cost and schedule performance data broken down both by program work breakdown structure (format 1); contractor functional organizations (format 2); baseline information

(format 3); planned vs. actual manpower usage (format 4); and problem analysis (format 5).

The CPR provides the Government program office with an objective indication of contract status, a basis for observing trends, and a way to focus management attention on significant problem areas. This, in-turn, facilitates day-to-day contract management and enhances communication with contractors. According to the C/SCSC JIG, the CPR should not be relied upon to provide the first indication of problems. Rather, it should be used to confirm and quantify known problems, allowing for analysis of the effect on current and future contract cost and schedule.

Additionally, procuring activities incorporate CPR data into various oversight reports that provide program status to higher authorities, including the Office of the Secretary of Defense (OSD) and Congress. Because of budget cuts and ill-fated programs like the A-12, high-level interest in CPR data has increased noticeably during this decade.

3. Subsidiary question #2:

What are the key earned value (C/SCSC) considerations in request for proposal (RFP) preparation, and what evaluation/validation procedures are employed for DOD contracts requiring C/SCSC?

For all major contracts, the DOD FAR Supplement (DFARS) clause 252.234.7000--"Notice of Cost/Schedule Control Systems", must be reflected in the request for proposal (RFP).

This clause requires offerors to submit as part of their proposal package a comprehensive plan for C/SCSC. The plan should describe the contractor's management control system (including its major subcontractors), and how it satisfies each of the 35 criteria. If the contractor has a previously validated system, an Advance Agreement (AA), which states the contractor's agreement to use the validated system on this and future contracts, can be substituted for the comprehensive plan for C/SCSC.

In addition to the DFARS clause 252.234.7000, other C/SCSC-related items in the RFP are statement of work (SOW), work breakdown structure (WBS), and contract data requirements list (CDRL). The SOW should state in specific, lucid terms, the procuring activity's needs for earned value management. The WBS should provide visibility into the relationship between the end product and elements of work. WBS reporting levels should be extensive enough to effectively monitor cost/schedule performance (usually level 3). The C/SCSC reports specified in the CDRL should be limited to those that will be effectively used, and be tailored to meet individual program needs.

Prior to contract award, a C/SCSC Evaluation Review is performed. This review consists of an analysis of the contractor's comprehensive plan for C/SCSC submitted in

response to the criteria prescribed by the RFP. Within six months after contract award an Integrated Baseline Review (IBR) should be conducted to assess the contractor's implementation of the performance measurement baseline (PMB). Then, depending upon whether the winning contractor has a previously accepted system, varying degrees of C/SCSC on-site validation review may be conducted.

Normally a contractor with a previously accepted system will undergo either a Subsequent Application Review (SAR) or an Extended Subsequent Application Review (ESAR). If the result of the IBR indicates that the PMB has been properly established and is being used by the contractor in the management of the contract, then a waiver of SAR may be appropriate.

A contractor who does not have a previously accepted C/SCSC system undergoes a different set of review actions. Upon award of a contract requiring C/SCSC, the contractor can expect to receive an Implementation Visit (IV), followed by a Readiness Review (RR). Every effort should be made to combine the IBR with the IV and/or RR to minimize the unnecessary repetition of work performed in previous reviews. Finally, when ready, the contractor will undergo a Demonstration Review to validate his system. Each of these reviews were discussed in detail in Chapter III, Section C.

4. Subsidiary question #3:

What are some significant technological and policy initiatives currently being undertaken or considered to improve the timeliness and utility of cost and schedule data?

The Performance Analyzer(PA) is a Government owned software program used for the analysis of CPR, C/SSR and CFSR data. Since its introduction in the late 1980s, the PA has undergone continuous improvements to meet the DOD's goal of simplifying, streamlining, and standardizing contractor performance analysis. The latest version of PA contains three modules that automatically calculate both current and cumulative cost and schedule variances, performance indices, and estimates at completion (EAC). Over 40 briefing quality charts and narratives can be generated, and 12 sort options can show the user cost and schedule performance status at any level of the WBS. The PA also allows for transfer of the above-mentioned reports using electronic data interchange (EDI). EDI capability has helped to overcome two major shortfalls of the C/SCSC process--the timeliness, and hence, usefulness of the CPR. In today's austere staffed Government procurement activities, the PA is an absolutely essential tool for effective program management.

With regard to policy initiatives, the "Model Program" approach proposed in 1993 by Gary Christle, Deputy Director of Performance Management within the Office of USD(A&T),

initiated several sweeping changes in the way the criteria are implemented. The main goal of this approach is to maximize the value of C/SCSC for both the Government and contractor. The key aspects of this approach include shifting the emphasis to contractors, using earned value as a risk management tool rather than as a reporting requirement, limiting reports for effective use, and performing early, comprehensive planning.

From a business standpoint, these initiatives make sense. The contractors should share in the ownership of program cost and schedule management. It is not unreasonable for the Government to expect that the contractor will pursue sound program planning, conduct realistic risk assessment, and implement proactive measures in order to deliver a product that is on schedule and on cost. Similarly, it is quite reasonable for contractors to expect that the Government will not interfere or otherwise hinder their progress by imposing excessive requirements and oversight. Hence, the success of the "Model Program" approach is heavily predicated on trust, open communication, and teamwork between Government and industry.

5. Subsidiary question #4:

What effect have the current Acquisition Reform initiatives had on the C/SCSC process?

With its strong emphasis on adoption of applicable commercial practices, streamlined acquisition procedures, and

reduced oversight/review requirements, Acquisition Reform has had a profound impact on the C/SCSC process. These basic tenets of Acquisition Reform have been assimilated into the C/SCSC process through several earned value management improvement initiatives. Three salient examples of this include the fusing of earned value management with the Integrated Product Process Development (IPPD) and Integrated Product Team (IPT) concepts, use of Electronic Data Interchange (EDI) for cost and schedule performance reporting, and the movement towards establishing an industry standard for C/SCSC along the lines of International Organization for Standardization (ISO) 9000. According to one OSD analyst, Acquisition Reform has brought about the following changes in earned value management:

- Fewer validation reviews
- Program Manager ownership of the C/SCSC process
- Emphasis on contractor responsibility
- Reduced recordkeeping and reporting
- Empowered Government and industry teams (Abba, 1995)

B. RECOMMENDATIONS

1. Procuring contracting officers should attend formal training to gain a sound working knowledge of C/SCSC.

The Contractor Performance Measurement (CPM) course conducted by the Defense Systems Management College (DSMC), and other member institutions of the Defense Acquisition University (DAU), is normally a one-week program designed specifically for functional managers who wish to enhance their understanding of C/SCSC. PCOs can benefit from instruction on contractual procedures for the implementation of C/SCSC, as well as from practical exercises in techniques of CPR data analysis. Information on course dates and locations can be obtained from the DSMC registrar's office.

2. **Each C/SCSC focal point should review its respective procuring agency's RFPs for adequacy and appropriateness of C/SCSC requirements before the RFPs are released to industry.**

A recent DOD internal review of major program RFPs released during the past 5 years identified significant misapplications of C/SCSC requirements. For example, 75 percent were found to have excessive variance analysis reporting and 50 percent had serious WBS problems. Consequently, the Government wound up paying for data that are of little or no practical use. It seems that, had such a review been conducted prior to the release of these RFPs, most (if not all) of these shortfalls could have been averted. Therefore, C/SCSC focal points at each major buying activities, as the policy experts, should conduct a final

"quality check" of all C/SCSC-related items in the RFP to ensure optimal implementation of the criteria.

C. CONCLUSION

The purpose of this thesis was to provide the PCO with an understanding of the importance of cost and schedule management to the success of a major acquisition program. Although, the material was intended to serve as a reference guide to PCOs, it is by no means all-inclusive. The broad and dynamic C/SCSC process encompasses several disciplines, including general management, accounting, statistics and computer science. Advances in these disciplines, as well as significant changes in Government acquisition policy and procedures, will continue to have an impact on how C/SCSC is implemented and applied.

APPENDIX A: LIST OF ACRONYMS

| | |
|------------|---|
| AA | Advance Agreement |
| ACAT | Acquisition Category |
| ACO | Administrative Contracting Officer |
| ACWP | Actual Cost of Work Performed |
| ANSI | American National Standards Institute |
| AP&PI/CM | Acquisition Policy and Program Integration/Cost Management |
| ASN (RD&A) | Assistant Secretary of the Navy (Research Development and Acquisition) |
| BAC | Budget at Completion |
| BCWP | Budgeted cost of Work Performed |
| BCWS | Budgeted Cost of Work Scheduled |
| B/FMT | Business/Financial Manager Trainee |
| CAE | Component Acquisition Executive |
| CAIG | Cost Analysis Improvement Group |
| CAO | Contract Administration Office |
| CAS | Cost Accounting Standards |
| CCDR | Contract Cost Data Report |
| CDRL | Contract Data Requirements List |
| CFSR | Contract Funds Status Report |
| CPFF | Cost-Plus-Fixed-Fee |
| CPI | Cost Performance Index |
| CPM | Contract Performance Measurement or Critical Path Method |
| CPR | Cost Performance Report |
| C/S | Cost/Schedule |
| C/SCSC | Cost/Schedule Control Systems Criteria |
| C-SPEC | Cost/Schedule Planning and Control Specification |
| C/SSR | Cost/Schedule Status Report |
| CV | Cost Variance |
| CWBS | Contract Work Breakdown Structure |
| DAB | Defense Acquisition Board |
| DAES | Defense Acquisition Executive Summary |
| DAU | Defense Acquisition University |
| DCAA | Defense Contract Audit Agency |
| DCMAO | Defense Contract Management Area Operation |
| DCMD | Defense Contract Management Command |
| DISA | Defense Information Systems Agency |
| DLA | Defense Logistics Agency |
| DLSIE | Defense Logistics Studies Information Exchange |

| | |
|--------|---|
| DOD | Department of Defense |
| DODI | Department of Defense Instruction |
| DPRO | Defense Plant Representative Office |
| DSMC | Defense Systems Management College |
| DTIC | Defense Technical Information Center |
| EAC | Estimate At Completion |
| EDI | Electronic Data Interchange |
| ESAR | Extended Subsequent Application Review |
| EWS | Early Warning System |
| FAR | Federal Acquisition Regulation |
| IBR | Integrated Baseline Review |
| IPPD | Integrated Product and Process Development |
| IPS | Integrated Program Summary |
| IPT | Integrated Product Team |
| ISO | International Organization for Standardization |
| IV | Implementation Visit |
| JIG | Joint Implementation Guide |
| LRE | Latest Revised Estimate |
| MDA | Milestone Decision Authority |
| MOA | Memorandum of Agreement |
| NAVSEA | Naval Sea Systems Command |
| NSA | National Security Agency |
| OIPT | Overarching Integrated Product Team |
| OSD | Office of the Secretary of Defense |
| PA | Performance Analyzer |
| PEO | Program Executive Officer |
| PERT | Program Evaluation Review Technique |
| PCO | Procuring Contracting Officer |
| PM | Program Manager |
| PMB | Performance Measurement Baseline |
| PMJEG | Performance Measurement Joint Executive Group |
| RFP | Request for Proposal |
| R&D | Research and Development |
| RR | Readiness Review |
| SAE | Service Acquisition Executive |
| SAR | Subsequent Application Review |
| SOW | Statement of Work |
| SPI | Schedule Performance Index |
| SSA | Source Selection Authority |
| SSEB | Source Selection Evaluation Board |
| SSP | Source Selection Plan |
| SV | Schedule Variance |
| TCPI | To Complete Performance Index |

| | |
|-----------|---|
| USD (A&T) | Under Secretary of Defense (Acquisition & Technology) |
| VAC | Variance At Completion |
| WBS | Work Breakdown Structure |
| WIPT | Working-Level Integrated Product Team |
| WWW | World Wide Web |

APPENDIX B: GLOSSARY OF C/SCSC TERMS

Ref. [DODI 5000.2, PART 11, SECTION B, ATTACHMENT 2]

1. Actual Cost of Work Performed (ACWP). The cost incurred and recorded in accomplishing the work performed within a given time period.
2. Actual Direct Cost. Those costs identified specifically with a contract, based upon the contractor's cost identification and accumulation systems as accepted by the cognizant Defense Contract Audit Agency representative.
3. Allocated Budget. The sum of all budgets allocated to the contract. Total allocated budget consists of the performance measurement baseline and all management reserve. The total allocated budget will reconcile directly to the contract budget base. Any differences will be documented as to quantity and cause.
4. Apportioned Effort. Effort that is not readily divisible into work packages, but is related proportionately to measured effort.
5. Authorized Work. Effort that has been definitized and is on contract plus that for which definitized contract costs have been agreed to, but for which written authorization has been received.
6. Baseline. See Performance Measurement Baseline.
7. Budgeted Cost of Work Performed (BCWP). The sum of the budgets for completed work packages and completed portions of open work packages, plus the applicable portion of the budgets for level of effort and apportioned effort.
8. Budgeted Cost of Work Scheduled (BCWS). The sum of budgets for all work packages, planning packages, etc., scheduled to be accomplished (including in-process work packages), plus the amount of level-of-effort and apportioned effort scheduled to be accomplished within a given time period.
9. Contract Budget Base. The negotiated contract cost plus the estimated cost of authorized unpriced work.

10. Cost Account. A management control point at which actual costs may be accumulated and compared to the budgeted cost of the work performed. A cost account is a natural control point for cost/schedule planning and control, since it represents the work assigned to one responsible organizational element on one contract work breakdown structure element.
11. Estimate at Completion (EAC). Actual direct costs, plus indirect costs allocable to the contract, plus estimate of costs (direct and indirect) for authorized work remaining.
12. Level-of-Effort (LOE). Effort of a general or supportive nature that does not produce definite end product.
13. Management Reserve (MR). An amount of the total allocated budget withheld for management control purposes, rather than designated for the accomplishment of a specific task or set of tasks. It is not a part of the performance measurement baseline.
14. Performance Measurement Baseline (PMB). The time phased budget plan against which contract performance is measured. It is formed by the budgets assigned to scheduled cost accounts and the applicable indirect budgets. For future effort, not planned to the cost account level, the performance measurement baseline also includes budgets assigned to higher level contract work breakdown structure elements and undistributed budgets. It equals the total allocated budget less management reserve.
15. Planning Package. A logical aggregation of far term work within a cost account which may be identified and budgeted in early planning, but is not yet defined into work packages.
16. Undistributed Budget. Budget applicable to contract effort that has not yet been identified to contract work breakdown structure elements at, or below, the lowest level of reporting to the Government.
17. Variance. Those differences between planned and actual performance requiring further review, analysis, or action. Thresholds should be established as to the magnitude of variances that will require variance analysis, and the thresholds should be revised as needed

to provide meaningful analysis during execution of the contract.

18. Work Breakdown Structure (WBS). A product oriented family tree composed of hardware, services and data which result from project engineering efforts during the development and production of a defense material item. A WBS displays and defines the product(S) and relates the elements of work to be accomplished to each other and to the end product.
19. Work Packages. Detailed tasks or material items identified by the contractor for accomplishing work required to complete the contract. A work package has the following characteristics:
 - a. It represents units of work at levels where work is performed.
 - b. It is clearly distinguishable from all other work packages.
 - c. It is assignable to a single organizational element.
 - d. It has scheduled start and completion dates and, as applicable, interim milestones; all of which are representative of physical accomplishment.
 - e. It has a budget or assigned value expressed in terms of dollars, man-hours, or other measurable units.
 - f. Its duration is limited to a relatively short time span or it is subdivided by discrete value milestones to ease the objective measurement of work performed.
 - g. It is integrated with detailed engineering, manufacturing, or other schedules.

APPENDIX C: LISTING AND DESCRIPTION OF THE C/SCSC

Ref. [DODI 5000.2, PART 11, SECTION B, ATTACHMENT 1]

1. Organization

- a. Define all authorized work and related resources to meet the requirements of the contract, using the contract work breakdown structure (WBS).
- b. Identify the internal organizational elements and the major subcontractors responsible for accomplishing the authorized work.
- c. Provide for the integration of the contractor's planning, scheduling, budgeting, work authorization and cost accumulation systems with each other, the contract work breakdown structure, and the organizational structure.
- d. Identify the managerial positions responsible for controlling overhead (indirect cost).
- e. Provide for integration of the contract work breakdown structure with the contractor's functional organizational structure in a manner that permits cost and schedule performance measurement for contract work breakdown structure and organizational elements.

2. Planning and Budgeting

- a. Schedule the authorized work in a manner which describes the sequence of work and identifies the significant task interdependencies required to meet the development, production, and delivery requirements of the contract.
- b. Identify physical products, milestones, technical performance goals, or other indicators that will be used to measure output.
- c. Establish and maintain a time-phased budget baseline at the cost account level against which contract performance can be measured. Initial budgets established for this purpose will be based on the negotiated target cost. Any other amount used for performance measurement purposes must be

formally recognized by both the contractor and the Government.

- d. Establish budgets for all authorized work with separate identification of cost elements (labor, material, etc,.).
- e. To the extent the authorized work can be identified in discrete, short span work packages, establish budgets for this work in terms of dollars, hours, or other measurable units. Where the entire cost account can not be subdivided into detailed work packages, identify far term effort in larger planning packages for budget and scheduling purposes.
- f. Provide that the sum of all work package budgets, plus planning package budgets within a cost account equals the cost account budget.
- g. Identify relationships of budgets or standards in work authorization systems to budgets for work packages.
- h. Identify and control level-of-effort activity by time-phased budgets established for this purpose. Only that effort which cannot be identified as discrete, short span work packages or as apportioned effort may be classed as level-of-effort.
- i. Establish overhead budgets for the total costs of each significant organizational component whose expenses will become indirect costs. Reflect in the contract budgets at the appropriate level the amounts in overhead pools that are planned to be allocated to the contract as indirect costs.
- j. Identify management reserves and undistributed budget.
- k. Provide that the contract target cost plus the estimated cost of authorized but unpaid work is reconciled with the sums of all internal contract budgets and management reserves.

3. Accounting

- a. Record the direct costs on an applied or other acceptable basis in a manner consistent with the budgets in a formal system that is controlled by the general books of account.
- b. Summarize direct costs from cost accounts into the work breakdown structure without allocation of a single cost account to two or more work breakdown structure elements.
- c. Summarize direct costs from cost accounts into the contractor's functional organizational elements without allocation of a single cost account to two or more organizational elements.
- d. Record all indirect costs which will be allocated to the contract.
- e. Identify the bases for allocating the cost of apportioned effort.
- f. Identify unit costs, equivalent unit costs, or lot costs as applicable.
- g. The contractor's material accounting system will provide for:
 - (1) Accurate cost accumulation and assignment of costs to cost accounts in a manner consistent with the budgets using recognized, acceptable costing techniques.
 - (2) Determination of price variances by comparing planned versus actual commitments.
 - (3) Cost performance measurement at the point in time most suitable for the category of material involved, but no earlier than the time of actual receipt of material.
 - (4) Determination of cost variances attributable to the excess usage of material.
 - (5) Determination of unit or lot costs when applicable.

- (6) Full accountability for all material purchased for the contract, including the residual inventory.

4. Analysis

- a. Identify at the cost account level on a monthly basis using data from, or reconcilable with, the accounting system:
 - (1) Comparison of budgeted cost for work scheduled and budgeted cost or work performed;
 - (2) Comparison of budgeted cost for work performed and actual (applied where appropriate) direct costs for the same work; and
 - (3) Variances resulting from the comparisons between the budgeted cost for work scheduled and the budgeted cost for work performed and between the budgeted cost for performed and actual or applied direct costs, classified in terms of labor, material, or other appropriate elements together with the reasons for significant variances.
- b. Identify on a monthly basis, in the detail needed by management for effective control, budgeted indirect costs, actual indirect costs, and cost variances with the reasons for significant variances.
- c. Summarize the data elements and associated variances listed in subparagraphs 4.a.(1) and (2), above, through the contractor organization and work breakdown structure to the reporting level specified in the contract.
- d. Identify significant differences on a monthly basis between planned and actual schedule accomplishment and the reasons.
- e. Identify managerial actions taken as a result of criteria items in paragraphs 4.a through 4.d., above.
- f. Based on performance to date, on commitment values for material, and on estimates of future

conditions, develop revised estimates of cost at completion for work breakdown elements identified in the contract and compare these with the contract budget base and the latest statement of funds requirements reported to the Government.

5. Revisions and Access to Data

- a. Incorporate contractual changes expeditiously, recording the effects of such changes in budgets and schedules. In the directed effort prior to negotiation of a change, base such revisions on the amount estimated and budgeted to the functional organizations.
- b. Reconcile original budgets for those elements of the work breakdown structure identified as priced line items in the contract, and for those elements at the lowest level in the program work breakdown structure, with current performance measurement budgets in terms of changes to the authorized work and internal replanning in the detail needed by management for effective control.
- c. Prohibit retroactive changes to records pertaining to work performed that would change previously reported amounts for direct costs, indirect costs, or budgets, except for correction of errors and routine accounting adjustments.
- d. Prevent revisions to the contract budget base except for Government directed changes to contractual effort.
- e. Document internally the changes to the performance measurement baseline and notify expeditiously the procuring activity through prescribed procedures.
- f. Provide the Contracting Officer and the Contracting Officer's authorized representatives with access to the information and supporting documentation necessary to demonstrate compliance with cost/schedule control systems criteria.

APPENDIX D: BASIC EARNED VALUE ANALYSIS FORMULAS

Ref. (Maust, 1995)

| | | |
|-----|---------------------------------------|-------------------------|
| 1. | Schedule Variance (SV) | $BCWP - BCWS$ |
| 2. | Cost Variance (CV) | $BCWP - ACWP$ |
| 3. | Variance at Completion (VAC) | $BAC - EAC$ |
| 4. | Schedule Variance Percent (SVP) | $SV / BCWS \times 100$ |
| 5. | Cost Variance Percent (CVP) | $CV / BCWP \times 100$ |
| 6. | Variance at Completion Percent (VACP) | $BCWS / BAC \times 100$ |
| 7. | Percent Scheduled | $BCWS / BAC \times 100$ |
| 8. | Percent Complete | $BCWP / BAC \times 100$ |
| 9. | Percent Spent of BAC | $ACWP / BAC \times 100$ |
| 10. | Percent Spent of EAC | $ACWP / EAC \times 100$ |
| 11. | Schedule Performance Index (SPI) | $BCWP / BCWS$ |
| 12. | Cost Performance Index (CPI) | $BCWP / ACWP$ |
| 13. | Work Remaining (WR) | $BAC - BCWP$ |
| 14. | Cost Remaining (CR) | $BAC - ACWP$ |
| 15. | Estimate to Complete (ETC) | $EAC - ACWP$ |
| 16. | To Complete Performance Index (TCPI) | WR / CR |

LIST OF REFERENCES

Abba, Wayne, "Earned Value Management Rediscovered" A paper presented at the Program Executive Officer Conference, October 1995, Interviews with the author on 17 February 1996 and 12 April 1996.

Abba, Wayne, "Acquisition Reform and Earned Value," Seminar given at the Cost/Schedule Performance Management Conference, 22-26 October 1995.

Air Force Systems Command Pamphlet (AFSCP) 173-4 Guide to Analysis of Contractor Cost Data, Headquarters Air Force Systems Command, 01 September 1989.

Anderson, David R., Sweeney, Dennis J., and Williams, Thomas A., An Introduction to Management Science: Quantitative Approaches to Decision Making, West Publishing Company, Minneapolis/St. Paul, MN., 1994.

Berzazzani, Judith P., Steer, Lesley M., "An Introduction to the ISO 9000 Series: Quality Standards" National Contract Management Association Journal, June 1995.

Chasko, G. J., "Work Breakdown Structure," Defense Systems Management College, Contractor Performance Management Course Material, 01 October 1978.

Chen, John T., "Early Warning Systems," Seminar given at the Cost/Schedule Performance Management Conference, 22-26 October 1995. Interview with the author on 14 March 1996.

Christle, Gary, "Cost/Schedule Control Systems Criteria (C/SCSC) and Earned Value Management: A Vision," Transcript of statement presented at the National C/SCSC Conference, October 1993.

Christensen, David S., "Cost Overrun Optimism: Fact or Fiction?," Acquisition Review Quarterly Journal, Volume I, Number 1, Winter 1994, Interview with the author on 20 February 1996.

Christensen, David S., and Ferens, Daniel V., "Using Earned Value for Performance Measurement on Software Development Projects," Acquisition Review Quarterly Journal, Volume II, Number 2, Spring 1995.

Clark, Mary F., "The Principals of Performance Measurement," Seminar given at the Cost/Schedule Performance Management Conference, 22-26 October 1995.

Coutteau, Charles G., Cost and Schedule Control Management: What the Department of Defense Major Acquisition System Program Manager Needs to Know, M.S. Thesis, Naval Post-graduate School, March 1992.

Cukr, Anita J., "The Cost/Schedule Control Systems Criteria and ISO 9000," A paper presented at the 1995 Acquisition Research Symposium, March 1995.

Draft Cost/Schedule Control Management Guide (Version G), 15 May 1995.

Departments of Defense: Cost/Schedule Control Systems Criteria Joint Implementation Guide, 01 October 1987.

Department of Defense: Cost/Schedule Management of Non-Major Contract (C/SSR Joint Guide), 01 November 1978.

Departments of Defense: C/SCSC Joint Surveillance Guide, 01 October 1984.

Department of Defense Directive 5000.1, Defense Acquisition, February 1991.

Department of Defense Instruction 5000.2, Defense Acquisition Management Policies and Procedures, 23 February 1991.

Department of Defense Manual 5000.2-M, Defense Acquisition Management Documentation and Reports, February 1991.

Department of Defense "Guide to Integrated Product and Process Development," (Version 1.0), 05 February, 1996.

Department of Defense "Guide for Leading Successful Integrated Product Teams," November 1995.

Department of Defense Inspector General Audit Report, "Use of Contractor Cost and Schedule System Data," DI 93-067, 11 March 1993.

Durbrow, B.R., "C/SCSC Implementation Guide Reflects Evolution of the Program," Defense Management Journal, April 1974.

Finefield, Tony, "Review Expectations: IBRs and SARs," Seminar given at the Cost/Schedule Performance Management Conference, 22-26 October 1995.

Fleming, Quintin W., The Management Guide to C/SCSC, Probus Publishing Co., Chicago, IL., 1983.

Gadekan, Owen C., Tison, Thomas S., "The Cost of C/SCSC, Program Manager Journal, July-August 1983.

International Organization for Standardization (ISO), Compatible Technology Worldwide, Geneva, Switzerland, 1992

Kemps, Robert R., "The DOD Cost/Schedule Control Systems Criteria," Office of the Assistant Secretary of Defense (Comptroller), circa. 1978.

Kaminski, Paul G., "Performance Measurement Joint Executive Group," Memorandum to Component Acquisition Executives, 04 December 1995.

Kaminski, Paul G., Key Note Address at the Cost Schedule Performance Management Conference, 22-26 October 1995.

Kaminski, Paul G., "Reengineering the Acquisition Oversight and Review Process," Memorandum to Component Acquisition Executives, 28 April 1995.

Kaminski, Paul G., "Electronic Data Interchange (EDI) and Contract Cost Performance Reporting," Memorandum to Component Acquisition Executives, 25 January 1995.

Longuemare, R. Noel, "Improved Cost and Schedule Performance Management," Memorandum to Component Acquisition Executives, 25 January 1994.

Manzer, Fred, "Earned Value Considerations in RFP Preparation," Seminar given at the Cost Schedule Performance Management Conference, 22-26 October 1995, Interview with the author on 14 March 1996.

Mattox, Rickey T., "C/SCSC: Panacea or Plague,. Student Paper, Air Force Institute of Technology, June 1988.

Maust, Gregory E., "Advanced Earned Value Analysis," Seminar given at the Cost Schedule Performance Management Conference, 22-26 October 1995.

McGovern, John P., "DEPSECDEF Authorizes Using International Quality Standards," Program Manager Journal, May-June, 1994.

Nash, Ralph C. Jr., Cibinic, John Jr., Competitive Negotiation: The Source Selection Process, George Washington University Press, Washington, D.C., 1993.

Pugh, James E., Evaluation of Procedures Employed During Source Selection for Contracts Including Clauses Requiring Cost/Schedule Control Systems Criteria (C/SCSC), M.S. Thesis, Air Force Institute of Technology, 1985.

Sherman, Stanley N., Contract Management: Post Award, Wordcrafts Publications, Gaithersburg, MD, 1987.

Sweeney, Edward J., An Evaluation of the Utility of Automated Cost/Schedule Control Systems Criteria (C/SCSC) Reporting at Naval Air Systems Command Headquarters, M.S. Thesis, Naval Postgraduate School, June 1992.

Schiller, Gregory G., "Cost Schedule Control Systems Criteria: Tips for Non-Routine Users," Student Paper, Air Force Institute of Technology, March 1991.

Weisburg, Louis, "C/SCSC: Validation Integrity Maintained by DCAS Surveillance Function," Defense Management Journal, April 1974.

World-Wide-Web, <http://WWW.acq.osd.mil/pm/>, Earned Value Management Home Page, "C/SCSC Industry Standard," 20 February 1996.

Yacoub, Mourab, Branch Manager for C/SCSC at the Naval Sea Systems Command, interview with the author on 18 November 1995.

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